AGRICULTURAL EDUCATION IN THE UNITED STATES

According to *The Journal of the Ministry of Agriculture*, London, agricultural education in the United States of America during the past thirteen years has made remarkable progress through the development of the extension movement. This development dates from the introduction of the Smith-Lever Act in 1914, the keynote of which is co-operation. Prior to this Act, colleges were conducting considerable extension work with their own funds, and the Federal Department of Agriculture was spending, independently of the colleges, a further sum of 1,000,000 dollars. This work is now carried out by a single division, organized at the college, with a director at its head, appointed by the college with the assent of the Secretary of Agriculture. There is further co-operation between colleges in part of the extension work and in the plan for the voluntary pooling of all funds available for the various States.

In 1914 the State and Federal Governments were spending 1,600,000 dollars on extension work in agriculture and home economics, and, by 1924, this figure had increased to 19,394,639 dollars per annum, of which approximately 12,000,000 dollars were contributed by the States and counties.

In the same period, the total personnel increased from 1,230 to 4,764 officers, the latter figure including 765 full-time specialists, extension directors, and other supervisory officers.

In determining the policy of the extension work for a district, the farmers, with the agents of the co-operating county, State and Federal Governments, together review the local conditions and agree upon what ought to be done. The administration of the work is then entrusted to the State College of Agriculture. The full recognition of local people, conditions and practices, and the enlistment of the active participation of the individual farmer and his family in the planning and the carrying out of local extension work, are the two fundamental considerations to which the success is accredited. Demonstration farms are owned and operated by the farmers under schemes developed jointly by the farmers and the Government agents. This partnership of the farmer with the Government, together with his work as a voluntary helper in the capacity of demonstrator, chairman or member of committee, has developed a sense of rural leadership, and given to the farmer a greater breadth of outlook, apart from the more direct benefit which accrues from the opportunity of improving his technical efficiency. The primary object of extension work, however, is

the adoption of an improved practice, and there is evidence of a much wider use by farmers of lime, cover crops, green manures, fertilisers, seed of improved and standardised varieties, and of the improvement of orchards by renovation, pruning, and spraying.

Farmers are advised as to the formation of co-operative organisations for the disposal of their products and for the purchasing of their supplies, provided with general information on marketing problems, encouraged to adopt better business principles, and stimulated to keep and utilise farm records as a means of regulating their business.

—*Agricultural Journal*, (Queensland).

In China men-who-work-with-their-hands-at-dawn, to use the analysis of the character "agriculture," are regarded as being of the utmost importance, ranking next only to scholars in the social scale; and nowhere can their well-tried methods be better studied than on either shore of the Great River. Beyond reed banks, stretch fertile fields, where blue-coated men and women tend their crops literally "throughout the period of the sun's light." At dawn the first objects to be clearly distinguished, are human figures in the fields, weeding, weeding, weeding; and when yellow dusk turns to darkness those same figures melt away, still weeding, weeding, weeding.—Florence Ayscough, In *A Chinese Mirror*.

There are seven mistakes of life that many of us make," said a famous writer, and then he gave the following list:

The delusion that individual advancement is made by crushing others down.

The tendency to worry about things that cannot be changed or corrected.

Insisting that a thing is impossible because we ourselves cannot accomplish it.

Refusing to set aside trivial preference in order that important things may be accomplished.

Neglecting development and refinement of the mind by not acquiring the habit of reading.

Attempting to compel other people to believe and live as we do.

The failure to establisb the habit of saving money.—*The Aberdeen-Angus Journal.*

THE NAGOYA, A NEW IMMIGRANT FROM JAPAN[1]

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WITH THREE TEXT FIGURES

The "Nagoya," a dual purpose fowl, was recently introduced into the College of Agriculture at Los Baños from Japan where this breed of fowls

Fig. 1.—A male Nagoya. This is one of the four roosters raised from the eggs brought from Japan in 1926.

makes up a large portion of that Empire's poultry population. When the junior author, Dean Gonzalez, returned in 1926 from Tokyo, where as a delegate he had attended the Pan-Pacific Scientific Congress, he brought

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with him eggs of this breed. When this was done we had little idea that something that may help solve the country's call for more eggs and poultry of good quality was being introduced in the College. The chickens hatched from these eggs, fourteen in all, in spite of their being new to our local conditions, performed so well that we do not hesitate to recommend this breed even to beginners in chicken raising.

As the foundation stock of the Nagoya was a cross of Japanese "farm fowls and Shanghais which were imported into Japan from South China in the latter part of the nineteenth century" it is very probable that this breed carries some blood of our popular Cantonese breed.[2] This bit of history

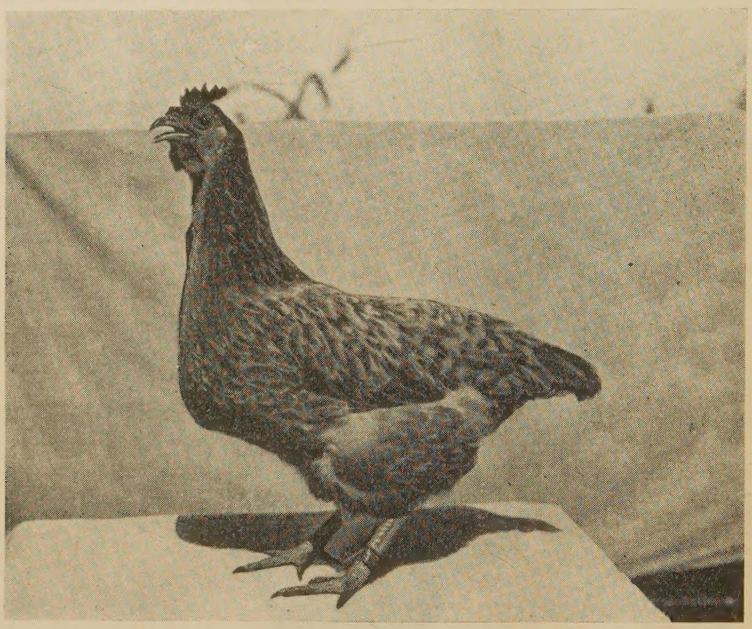

Fig. 2.—A female Nagoya. This is one of the four hens raised from the eggs brought from Japan in 1926.

is important for the reason that as the Cantonese has already proved its worth in the Philippines, being capable of multiplication and improvement under local conditions of environment, we may reasonably expect the same of the Nagoya. The small number of chickens raised in this College during the two years since the Nagoya eggs were brought here indicate that our conclusion is justified; also the layers that are now under observation are performing beyond our modest expectations as to the value of these fowls.

While work in the improvement of the "Los Baños Improved Cantonese" had its early beginnings with a raw and unfinished material, this newly

[2] Susaki, Shinji. 1927. On "Nagoya" one of dual purpose poultry breeds originated in Japan. Proceedings of World's Poultry Congress (1927): 60–63.

introduced Nagoya breed of fowls is almost a finished product. The eggs are uniformly strong-shelled, large, healthy brown in color, that is, brown with a pinkish tinge, not unlike the Rhode Island Red eggs in both size and color, although the Nagoya eggs are perhaps a little the larger.

The number of Nagoya eggs brought in the introductory settings was thirty. These eggs were laid in Japan from November 11 to 17, 1926, and when weighed in the College on December 1 following, the date when these eggs were placed under hens for incubation, the weights ranged from 53.5 to 72.0 grams each, with an average of 62.0 grams; the weight would have been more had the eggs not been 14 to 20 days old. It may be many years before this size in eggs will be reached with our improved Cantonese, but increase in size of eggs is one of the goals towards which our work aims. In color, the Cantonese eggs now compare very favorably with the Nagoya.

Fig. 3.—The present flock of Nagoya fowls in the College of Agriculture, January, 1929.

Fourteen chicks were hatched out of the original thirty eggs. This hatch was a great deal better than was expected, for the eggs had travelled for about a week across none too smooth seas. The eggs were packed well in rice hulls in a box. Under arrangement with the ship officers these eggs were placed in the vegetable refrigerating room. This courteous co-operation of the officers (S. S. *President Jackson*) helped considerably in the success of the importation as the eggs were placed at a temperature where the development of the embryos was not possible. Under less favorable conditions of transportation, we venture to state that the good hatching result would not have been possible. This experience suggests the possibility of importing eggs of improved breeds of chickens into the Islands rather than the fowls themselves. It would be cheaper, less trouble and would minimize the danger of disease introduction.

The baby Nagoya chicks are much like the Cantonese in color but they are much larger in size. In about two weeks after hatching, the original yellow shanks and beaks turn slate, or bluish in color. As the chicken matures this color becomes pronounced. The skin is white. The mature fowls have feathers with the same Columbian color pattern as the Cantonese, the color of plumage, however, is less uniform and a shade deeper than the rich golden buff of the Cantonese, although it is not as deep red as the Rhode Island Red. In size, the mature individuals compare very favorably with the Rhode Island Reds, although they do not look as heavy because the Nagoyas are rather closely feathered. Because of the close feathering, the Nagoya appears to be more leggy than the Rhode Island Red. The mature male fowl weighs on the average 2.25 kilograms and the female, 1.75 kilograms. The Japanese Standard of Perfection for this breed is 2.5 kilograms (5.5 lbs.) for a cockerel and 1.8 kilograms (4.0 lbs.) for a pullet. The four cocks raised from the thirty eggs average 2.27 kilograms and the four hens average 1.83 kilograms, while the standard requires 3.41 kilograms (7.5 lbs.) for a cock and 2.73 kilograms (6.0 lbs.) for a hen[3].

Out of the fourteen chicks hatched, eight were raised to maturity, four males and four females. Of the six that were lost during the brooding period, three were stolen by hawks, and three died of disease caused by intestinal round worms. Considering the fact that the breed was just from a country of much colder climate than ours, this record of the Nagoya may be considered as exceptionally good. The effects of the sudden change of climate from cold to warm was apparently shown in the rate of growth and delayed maturity of the birds. The chicks grew well during their early life, but after several months, when they were out in the open most of the time, the rate of growth slackened considerably. As a result, the four original pullets were rather late in maturing. In Japan, the Nagoya grows very quickly, the pullets maturing when six months old[4]. But under our conditions, the four pullets did not begin to lay until they were almost a year old, the youngest to lay being only a month and seven days short of one year, whereas the oldest to lay was a year and eight days old. These four pullets have just completed their first laying year with a fairly good egg production record, considering that they are recent immigrants. The individual record for the year is 106, 74, 91, and 98 eggs each; records that may be considered very good especially for birds that were hatched from eggs that had had an unusual history.

The Nagoya has one weakness. The majority of our small flock of these fowls, the males particularly, are affected with scaly legs. The other birds in the College flocks, although as heavy as the Nagoyas, are not as susceptible to this leg trouble. However, this should not be considered as a serious drawback, as scaly leg can be easily controlled with the regular application of vaseline or a mixture of coconut oil and kerosene. Pure

[3],[4] *loc. cit.*

kerosene may be used, but the result is not so satisfactory as the mixture with oil. Waste oil from automobiles and other machines may be used to a great advantage in the control of these parasites.

The principal points in favor of the Nagoya breed may be enumerated as follows:

a. The fowls are strong, hardy and seem to adapt themselves to local environmental conditions.

b. They are fairly large-sized, and they lay a fair average of large eggs with uniformly brown shells.

c. The plumage color is fairly even; and the body type is uniform.

The Japanese standard for this breed contains, among other things, the following points:[5] The comb is single, and the tail is medium in size. The beak is stout and the body is long, broad, deep, and full. The wings are medium in size, the upper half web of the primaries is reddish buff, lower half, black; secondaries upper half web, black, lower half, buff; primary coverts, black. In the male, the sickles and main tail feathers are black with greenish lustre; the tail coverts, black, changing to buff as they near the saddle. The rest of the body feathers are buff. The shanks and toes are lead colored, and feathered shanks are a disqualification.

[5] *loc. cit.*

COMPARATIVE ANALYSES OF AMERICAN AND PHILIPPINE CIGARETTES[1]

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It is well known that the quality of tobacco depends upon many factors, the most important being the climate, the soil in which the plant is grown, the fertilizer used, the variety of the plant grown, the method of culture, the stage at which the leaves are picked, and the method of curing followed. The chemical changes that take place in the production of other crops such as corn or rice, may be as complex as those that take place in the production of the tobacco leaf, but with no crop is the taste of the consumer so critical as with tobacco. Certain definite qualities in tobacco, such as its burning quality, toughness, pliability, color and aroma, must satisfy the consumer, otherwise the product is not marketable.

The aim of the present work was to find the differences in composition between the cigarettes of American manufacture and those made in the Philippines, with the object of determining whether the desirable qualities of the American cigarettes can be imparted to Philippine tobacco leaves.

REVIEW OF THE LITERATURE

The changes that take place in the curing of tobacco are known, at least in a general way. Thus, according to Behrens (1895), the following changes take place during the drying of tobacco: (*a*) the dry weight decreases; (*b*) the salts of organic acids increase; (*c*) the nitrogenous substances decrease, although the amids increase and the nicotine content does not change; (*d*) the ethereal oil evaporates; and (*e*) the salts of sulfuric acid increase. According to the same authority, the following changes take place in the later stages of curing: (*a*) the dry weight decreases because of loss in carbohydrates and organic acids; (*b*) a part of the nicotine disappears; (*c*) the nitric acid is completely eliminated; (*d*) asparagin disappears, while amido acids appear; (*e*) the weight of ether extractable substances is decreased; and (*f*) a gaseous substance (possibly butyric acid) is formed.

These results are more or less verified by other workers. Thus Garner and Bacon conclude from their experiments that the starch is first transformed into the sugars which in turn are transformed into oxalic, citric, and malic acids and finally decomposed into carbon dioxide and water. The pentosans behave in a similar manner. The protein substances of

[1]Experiment Station contribution No. 589. Received for publication September 28, 1928

the leaf, however, are changed into the amid and amido derivatives and finally are transformed into ammonia, carbon dioxide, and water.

The relation between the quality of tobacco and its chemical characteristics has been studied by several workers. Among them may be mentioned A. Schmuck and Balabuha-Popzowa (1927) who arrived at the conclusions that: (*a*) the amount of carbohydrates together with that of polyphenols increases in the samples of tobacco of higher quality; (*b*) the amount of protein and total nitrogen decreases in the samples of better quality while the nicotine content and the ash content increase in tobacco of inferior quality; (*c*) the ratio of total carbohydrates to the protein is a good index of the quality of tobacco, the higher ratio indicating tobacco of superior quality; (*d*) dark colored tobaccos contain a greater amount of nicotine, protein, and total nitrogen, and less carbohydrates and phenols than lighter colored tobaccos, the latter being therefore superior in quality to the former.

Furthermore, the supposition that the greater the carbohydrate content of tobacco the brighter the color has been verified by Schmuck and Semenova (1927). The same investigation showed that tobacco (either green or fermented) contains, besides carbohydrates, fairly large amounts of substances (probably polyphenols) which reduce Fehling's solution. These substances may alter the carbohydrate content of the tobacco, and indicate its aroma, although the absolute content of these phenols show very little relation to the color of the tobacco.

Piatnitzki (1927), working on the chemical composition of the leaves from different pickings, found that the percentages of the total nitrogen, protein nitrogen, nicotine, free organic bases and tobacco resins increase from the lower (first) picking to the upper picking, while the amounts of malic acid, total organic acid and ash decrease from the lower to the upper pickings. He also found that the polyphenol substances, as a rule, increase from the lower to the upper pickings, although in some cases, the maximum content of these substances is found in pickings between the first and last.

De Vries and Sidenius (1916) working on the burning quality of tobacco, studied three factors; namely, the duration of glow, the color of the ash, and the percentage composition of the ash. According to these investigators, the greater the duration of the glow and the whiter the ash, the better is the quality of tobacco. Furthermore, tobacco of superior quality contains less ash (total percentage), and less chlorine and SiO_2 in the ash.

The nature of the aromatic substances in tobacco has been studied by Schmuck (1926) who found that in the benzene extract of tobacco there is a substance, insoluble in petroleum ether, ether and water, which possesses a pleasant weak aromatic odor and which upon burning forms aromatic products having an irritating influence on the mucous membrane; while in the alcohol extract, there is another substance, insoluble in petroleum ether, ether, carbon bisulfide, or water, but soluble in methyl alcohol, which

gives a pleasant smoke when burned, and which reduces Fehling's solution upon heating with HCl.

Graham and Carr (1924) obtained results somewhat similar to those of Schmuck. They found that the vegetable waxes, volatile oils, and loosely combined nicotine contained in the petroleum ether extract are responsible for much of the irritating effect of the tobacco. They, furthermore, found that although the composition of tobacco may be greatly improved by different fertilizer treatments, the tobaccos which command the best price in the market are those which are grown on relatively poor sandy or clay soil, and which are characterized by a low percentage of the extractives, proteins, and nicotine. These characteristics apply mostly to cigar tobaccos; they found that smoking tobacco is characterized by a high percentage of extractives in petroleum ether, ether, and alcohol. It may be pointed out, in passing, that benzene and petroleum ether extract the vegetable waxes, ethereal oils, phenols, some chlorophyl and some nicotine; ether extracts resins, some glucosides, much nicotine and some chlorophyl; ethyl alcohol extracts sugars, tannins, some resins, and the remaining nicotine; while boiling water extracts acids, mucilage, carbohydrates and albumin.

MATERIALS AND METHODS USED

Ten brands of American-made cigarettes, sixteen of Philippine-made cigarettes and five different varieties of tobacco cured in the Department of Agricultural Chemistry of this College[2] were used in the analyses. All the American cigarettes were obtained in the local market. The Fatima, Piedmont, Chesterfield, Cycle, and Camel brands are too well known to need description. The Diamond and Rubi brands are manufactured in the Philippines but are made from leaves cured in the United States. The Condax is manufactured by E. A. Condax and Co., Inc. in the United States, the Aztecas by the Golden West Tobacco Co. (of California), and the Benaderets' by S. Benaderet, Inc. of San Francisco, California.

The Philippine brands used are the La Insular, Cagayanes, La Dalaga, La Dicha, Rositas, Lakandula, Mileguas, La Brisa Filipina, Londres (cigars) and Favoritos de J. Santa Marina (cigars). Besides these cigarettes and cigars, three grades of tobacco leaves sent by the Alhambra Cigar and Cigarette Manufacturing Co., were used. According to this company, the first and second grade leaves come from the Isabela region, and the third grade (which is cigarette tobacco) is a mixture of Isabela and Cagayan leaves. The samples of Favoritos de J. Santa Marina (cigars) and La Insular (cigarettes) were sent by the La Insular Cigar and Cigarette Factory, Inc., and are considered by this company to be its best brand; the Londres (cigars) and the La Brisa Filipina (cigarettes) from the same company are its lowest

[2] The method of curing followed together with the conditions affecting the qualities of the leaves, will form the subject of another article.

priced products. The other Philippine brands were bought in the local market. Besides these brands of manufactured tobacco, six varieties of tobacco grown in Los Baños Municipality and cured and treated in the laboratory of the Department of Agricultural Chemistry of this College were used. H_3 is a hybrid of Improved Gold Leaf and the native tobacco from San Antonio, Los Baños. I_7 is Texas Cuban tobacco introduced in the College in 1914. I_9 is Connecticut Havana tobacco. N_{45} is a variety called *alafug* from Tuao, Cagayan. N_{41}, according to records, is Repollo mixed with Pampano and Espada Bacalao; it was obtained from Naguilian, Isabela. N_{57}, according to the records, is 40-Espada, obtained from the Ilagan Tobacco Experiment Station. Mixture A was a mixture of unidentified tobacco leaves grown and cured in the Department of Agricultural Chemistry of this College. The soil in which these varieties were grown is clay loam—no fertilizer was applied.

The method of analysis used consists in successively extracting the dried powdered tobacco in hot benzene, ether, 95 per cent alcohol and water. Weighed samples were placed in thimbles and each was hung by means of a wire in a 500 cc. Erlenmeyer flask on top of which is a condenser. (The set-up is similar to that for the extraction of oil). Two hundred cubic centimeters of the solvent were allowed to flow slowly from the top of the condenser through the powder. The flask was then heated, taking care that the rate of flow of the drop from the condenser tube to the sample was between one to two drops a second.

Experience had shown that it required about six days (of eight hours a day) of extraction with benzene before subsequent extractions failed to give any residue; two and one-half days were required for ether, and six and one-half days for alcohol to give the same results. These periods of extraction were, therefore, used in the analysis. In the case of water, the time allowed for extraction was only one day, even if the drops coming from the thimble were found to be somewhat colored; for comparative purposes the results obtained seemed to be sufficient. After each extraction the solution was placed in a flask or beaker and evaporated in a steam bath to a solid consistency.

It was noted that in the extraction with benzene and with alcohol a residue was left in the extractor flask. This may be explained by considering that in the method of heating used, no attempt was made to prevent local overheating at the bottom, so that it would be expected that a part of the extractive would be carbonized or decomposed, thus giving the residue observed. This is an important source of error in the determination. Another source of error is in the heating in the steam bath. One hour of heating may change the quantity of extraction by about 0.5 per cent owing to the disappearance of the more volatile constituents. This is why the alcohol extract was not expressed to an accuracy less than one per cent.

In order to discover further differences between American-made and Philippine-made cigarettes, the percentages of ash, protein nitrogen, and total nitrogen were determined according to the Official and Tentative Methods of Analysis of the Association of Official Agricultural Chemists (1920).

DISCUSSION OF RESULTS

Table 1 shows the percentages of the different extracts obtained from American-made cigarettes.

Table 2 shows the percentages of the different extracts obtained from Philippine-made cigarettes and a few cigars.

Table 3 shows the percentages of the different extracts obtained from Philippine cigarettes the tobacco of which was cured in the Department of Agricultural Chemistry.

Steam treatment was applied upon some of the brands with the object of testing whether this treatment would improve the quality of the cigarettes.

Table 4 shows the amount of ash, protein, nitrogen and total nitrogen in the different cigarettes.

Tables 1, 2, and 3 show that the great difference between the Philippine-made cigarettes and those of American manufacture is that the percentages of extractives (except the water extraction) in the American is much higher than the Philippine cigarettes. Thus the average benzene extract for Philippine cigarettes was 7.5 per cent, while that for American cigarettes was 10.8 per cent. The percentages of the benzene extracts for the cheap Philippine cigarettes, such as La Insular, Cagayanes, La Dalaga, La Dicha, Rositas and La Brisa Filipina all lie between 5.6 to 7.4 per cent. The more expensive cigarettes have higher benzene extracts—thus Lakandula had 10.6 per cent and Mileguas had 9.0 per cent. The cigars, as the Favoritos de Santa Marina, Londres, and Isabela 1st and Isabela 2nd, are all characterized by a fairly high benzene extract. The lowest benzene extract among the American cigarettes analyzed was 8.5 per cent (Aztecas) and the highest, 12.9 per cent (Camel). The cigarettes cured in the College Laboratory had benzene extracts varying from 9.4 to 13.7 per cent. The same varieties (H_3, I_7, and I_9 in table 2) when cured in the ordinary way in the barn for one year also yielded high benzene extracts (10.6 to 14.4 per cent).

The effect of steaming on Philippine-made cigarettes varied—in some cases the benzene extract was increased, while in other cases it was decreased. The same is true of cigarettes the tobacco of which was cured in the College Laboratory. In American cigarettes, however, the general tendency is an increase in the benzene extract when the cigarettes are steamed.

A comparison of the ether extracts leads to the conclusion that American cigarettes contain about twice as much ether extractive as the Philippine cigarettes; the cigarettes, the tobacco of which was cured in the College Laboratory yielded ether extracts midway between the two.

It is evident from the comparison of the alcohol extracts that Philippine-made cigarettes have much lower alcohol extracts than American-made cigarettes, the former ranging from 7 to 18 per cent, and the latter from 19 per cent (Aztecas) to 36 per cent (Piedmont). The average for Philippine-made cigarettes is 10 per cent, and for American cigarettes it is 29 per cent, and for Philippine cigarettes of tobacco cured in the College Laboratory, it is 24 per cent. It is doubtful if this difference between the American-made cigarettes (except a few) and those of tobacco cured in the College laboratory can be ascribed solely to the presence of petuning substances in the former, as it appears that the flavor and aroma of most American cigarette leaves are sufficient; no additional flavoring is needed. The high percentage of the alcohol extract in American-made cigarettes and those cured in the College Laboratory is ascribed to the presence of a large quantity of sugars which have resulted from the almost complete decomposition of the starch.

Steaming appears to increase the alcohol extractives in the case of Philippine-made cigarettes and those cured in the College Laboratory, while in the case of American-made cigarettes, the reverse (decrease) is observed. The reason for this may be that in the preparation of the American cigarettes so much steaming had been done that further steaming resulted in the volatilization of the more volatile constituents of the alcohol extract.

It is interesting to note that while the varieties H_3, I_7, and I_9 which were cured in the usual way for one year, and the Lakandula and Favoritos de J. Santa Marina gave high benzene extracts, their ether and alcohol extracts are all comparatively low, showing that the starchy material of the leaf had not been completely reduced to the sugars.

A comparison of the water extract shows that American-made cigarettes have a lower percentage of water extractives than Philippine-made cigarettes, and that the leaves cured in the College Laboratory have water extractives about midway between the two. Only in the constituents of this water extract are the American-made cigarettes apparently deficient. Steaming seems to have the effect of decreasing the percentage of the water extract.

It is possible from the above considerations that an index may be determined whereby one could tell from extraction methods, the suitability of cured tobacco leaves for cigarette purposes. In table 5, the sum of the benzene, ether, and alcohol extracts is termed A, the water extract is termed B, and the values of $\frac{A}{B}$ and $\frac{A}{A+B}$ are calculated.

The values of $\frac{A}{B}$ for the different samples are illuminating, and have a certain similarity to the ratio proposed by Schmuck and Balabuha-Popsowa. If we take such brands as the Camel, Fatima, and Chesterfield as

the standards, then a good type of cigarette may be defined as that whose $\frac{A}{B}$ ratio is not less than 2.0. It may be explained that one reason why some of the American-made cigarettes have high $\frac{A}{B}$ ratios, is that petuning substances are used. It will also be seen from table 5 that Aztecas, which seems to be inferior to the standards mentioned above, has a low $\frac{A}{B}$ ratio. From the same table, it will be seen that the leaves cured and made into cigarettes in the College Laboratory have $\frac{A}{B}$ ratios varying from 1.3 to 2.1. From smoking observations, the I_7 was classed as similar to Piedmont, while the other varieties gave smoking characteristics somewhat inferior to those of I_7. All the Philippine-made cigars and cigarettes studied gave $\frac{A}{B}$ ratios below 1.3, the cigarettes ranging from 0.4 to 0.8 and having an average ratio of 0.6, and the Londres and the Alhambra 1st (cigars) both giving 1.2.

Another index worthy of consideration is the $\frac{A}{A+B}$ ratio. It will be seen from the table that while American-made cigarettes have $\frac{A}{A+B}$ ratios varying from 0.6 to 0.8 (Aztecas has 0.5), and the cigarettes cured in the College Laboratory have ratios varying from 0.5 to 0.7, the Philippine-made cigarettes (and cigars) have ratios varying from 0.3 to 0.5.

Since the percentage of the ether extract is small, the value of the ratio $\frac{A}{A+B}$ will not be changed if the ether extract is not included in the calculation of A; furthermore, in the alcohol extraction this will be most nearly dissolved. Three extractions will therefore suffice to obtain this ratio $\frac{A}{A+B}$; namely, the benzene, alcohol and water extracts.

Finally, table 4 shows the difference in the nitrogen and ash contents of the American-made and Philippine-made cigarettes. It is to be noted that the protein nitrogen, total nitrogen, and ash contents in Philippine-made cigarettes (and cigars) are higher than in either the American-made cigarettes or those cured in our laboratory, the last two groups having approximately the same percentages of these constituents[3]. Steaming

[3] N_{41} has high percentages of protein nitrogen and total nitrogen because it was steamed with ammonia.

appears to have the effect of lowering the nitrogen content of cigarettes. In fact, experience shows that Philippine cigarettes taste better and lack that characteristically bitter taste, when they are steamed for one or two hours and dried before using.

It may be pointed out that in the manufacture of some cigarettes in the Philippines, the stems are generally included, but this would raise the ash content only by about one per cent. Even taking this difference into consideration, it is seen that the ash content of Philippine-made cigarettes is higher than that of American-made cigarettes by about three per cent.

SUMMARY

Comparative analyses of American-made cigarettes, Philippine-made cigarettes, and cigarettes cured in the College Laboratory showed that Philippine-made cigarettes have lower benzene, ether, and alcohol extractives, but higher water extractive than American-made cigarettes; the cigarettes made from tobacco grown in Los Baños and cured in the College Laboratory give extractives about midway between the two. The ash, total nitrogen and protein of Philippine-made cigarettes are also higher than American-made cigarettes or those cured in the College Laboratory.

In some cases the quality of cigarettes cured in the College Laboratory was similar to that of Piedmont, the aroma, color, pliability and burning quality approximating those of many standard American cigarettes.

An index was found whereby it could be determined whether or not a tobacco is good for cigarette purposes.

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TABLE 1

Composition of American-made cigarettes

NAME OF BRAND	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			per cent	*per cent*	*per cent*	*per cent*
Fatima	1	None	10.0	2.0	32	17
Piedmont	2	None	9.9	2.6	36	14
Chesterfield	54	None	10.3	—	—	—
Cycle	6	None	9.4	1.8	26	18
Camel	14	None	12.9	1.9	24	17
Condax	13	None	12.7	1.1	25	25
Aztecas	15	None	8.5	1.9	19	25
Diamond	29	None	10.4	2.4	34	22
Rubi	30	None	10.3	2.6	34	15
Benaderet's	47	None	12.5	2.1	21	17
Fatima	44	Steamed 2 hrs.	13.6	2.8	26	10
Piedmont	22	Steamed 3 hrs.	—	1.4	30	17
Chesterfield	21	Steamed 3 hrs.	15.6	1.9	26	20
Cycle	51	Steamed 2 hrs.	10.6	2.2	—	—
Camel	59	Steamed 2 hrs.	10.0	0.5	23	14
Diamond	57	Steamed 2 hrs.	9.0	—	13	17
Rubi	58	Steamed 2 hrs.	9.3	1.7	25	17
Average for the untreated cigarettes			10.8	2.1	29	19

TABLE 2

Composition of Philippine-made cigarettes

NAME OF BRAND	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			per cent	*per cent*	*per cent*	*per cent*
La Insular	3	None	6.6	0.4	10	27
Cagayanes	4	None	5.6	1.4	10	21
La Dalaga	7	None	5.8	0.2	8	38
La Dicha	8	None	6.5	0.5	9	36
Rositas	16	None	7.4	0.5	9	26
Lakandula	31	None	10.6	0.5	10	40
Mileguas	32	None	9.0	0.0	8	21
La Brisa Filipina	33	None	7.2	1.1	(18)?	(13)?
Londres[a]	34	None	8.3	1.7	10	17
Favoritas de J. Sta. Marina[a]	35	None	10.6	0.8	10	41
Alhambra, 1st	37	None	10.6	0.2	12	19
Alhambra, 2nd	39	None	8.8	0.9	7	32
Alhambra, 3rd	41	None	9.0	0.4	14	22
H_7 (1927)	45	Cured in barn for 1 year	12.9	0.8	15	26
I_7 (1927)	46	Cured in barn for 1 year	10.6	0.4	7	16
I_9 (1927)	48	Cured in barn for 1 year	14.4	0.5	13	25
La Insular	52	Steamed 2 hrs.	7.1	0.4	—	—
Cagayanes	56	Steamed 2 hrs.	6.8	0.7	—	—
La Dalaga	23	Steamed 3 hrs.	6.2	0.0	10	24
La Dicha	24	Steamed 3 hrs.	6.9	0.0	11	29
Rositas	60	Steamed 2 hrs.	8.1	0.1	8	21
Alhambra, 1st	38	Steamed 2 hrs.	10.4	0.0	12	28
Alhambra, 2nd	40	Steamed 2 hrs.	8.7	0.8	10	30
Alhambra, 3rd	42	Steamed 2 hrs.	8.3	—	—	—
Average for untreated Philippine-made cigarettes			7.5	0.6	10	27

[a]Cigars.

TABLE 3

Composition of Philippine tobacco cured in College Laboratory

VARIETY	EXPER. NO.	TREATMENT	BENZENE EXTRACT	ETHER EXTRACT	ALCOHOL EXTRACT	WATER EXTRACT
			per cent	*per cent*	*per cent*	*per cent*
H_3	12	None	9.4	0.9	24	27
M_3	20	Steamed for 1 hr. at 115° C.	9.2	2.3	27	18
H_2	19	Steamed under vacuum for 3 hr. at 72° C.	9.5	1.7	25	28
I_7	11	None	10.4	1.2	22	16
I_7	10	Steamed for 2 hours	10.2	1.7	27	7
I_7	9	Heated for 2 hours above 100° C.	10.2	1.2	23	14
I_9	17	None	9.6	—	20	23
I_9		Steamed for 1½ hr. at 115° C.	10.4	2.8	17	37
I_9	18	Steamed under vacuum for 3 hr. at 72° C.	9.8	1.1	19	30
N_{57}	25	Leaves dried above 100° C.	12.2	(0.1)	27	25
N_{57}	26	Leaves heated immediately after picking	14.4	1.4	25	22
N_{45}	28	None	13.7	0.9	24	23
N_{45}	27	Steamed for 3 hours	14.4	0.6	22	26
N_{41}	43	Steamed with NH_3 for 2 hours	11.1	0.0	24	19
Mixture A.	49	None	10.5	1.0	—	—
Mixture A.	53	Steamed for 2 hours	11.9	1.6	—	—
Average for the untreated samples			10.8	1.0	24	22

TABLE 4

Percentages of protein nitrogen, total nitrogen, and ash in different tobaccos

SAMPLE	TREATMENT	PROTEIN NITROGEN	TOTAL NITROGEN	ASH
		per cent	*per cent*	*per cent*
American-made cigarettes				
Diamond	None	1.96	2.20	15.6
Fatima	Steamed 2 hours	2.47	3.42	——
Piedmont	Steamed 3 hours	——	2.93	16.3
Rubi	None	2.13	2.34	——
Filipino cigarettes cured in College Laboratory				
I_9	Steamed 3 hours at 72° C	2.82	3.14	16.7
I_9	Steamed 1½ hrs. at 105° C	2.75	3.00	17.0
H_3	Vacuum steam 3 hrs. at 72° C	——	2.31	——
N_{41}	Steamed with NH_3 1½ hours at 105° C	4.17	4.31	15.1
Filipino-made cigarettes				
La Dalaga	Steamed 3 hours	——	2.92	——
La Dicha	Steamed 3 hours	3.02	——	——
La Brisa Filipina	None	2.76	3.31	19.7
Favoritos de J. Sta. Marina	None	3.82	3.89	20.7
Lakandula	None	3.76	3.57	19.4
Mileguas	None	3.17	3.34	21.4
Londres	None	3.50	3.86	19.4
1st Class (Alhambra)	None	4.30	——	19.0
1st Class (Alhambra)	Steamed 2 hours	4.33	4.45	18.8
2nd Class (Alhambra)	None	2.90	3.07	22.3
2nd Class (Alhambra)	Steamed 2 hours	2.60	3.94	21.1
3rd Class (Alhambra),	None	3.51	3.93	21.2
3rd Class (Alhambra)	Steamed 2 hours	3.14	3.40	20.8

TABLE 5

Showing indices $\frac{A}{B}$ *and* $\frac{A}{A+B}$

NAME OF BRAND OR VARIETY	TREATMENT	A BENZENE, ETHER AND ALCOHOL EXTRACTS	B WATER EXTRACT	$A+B$	$\frac{A}{B}$	$\frac{A}{A+B}$
		per cent	*per cent*	*per cent*		
American-made						
Fatima	None	44	17	61	2.6	0.7
Piedmont	"	49	14	63	3.5	0.8
Chesterfield	"					
Cycle	"	37	18	55	2.1	0.7
Camel	"	39	17	56	2.3	0.7
Condax	"	39	25	64	1.6	0.6
Aztecas	"	29	25	54	1.2	0.5
Diamond	"	47	22	69	2.1	0.7
Rubi	"	47	15	62	3.1	0.8
Benaderet's	"	36	17	53	2.1	0.7
Cured in the College laboratory						
H_3	None	34	27	61	1.3	0.6
I_7	"	33	16	49	2.1	0.7
I_9	"	30	23	53	1.3	0.6
N_{45}	"	37	26	53	1.4	0.7
Philippine-made						
La Insular	None	17	27	44	0.6	0.4
Cagayanes	"	17	21	38	0.8	0.4
La Dalaga	"	14	38	52	0.4	0.3
La Dicha	"	16	36	52	0.4	0.3
Rositas	"	17	26	43	0.7	0.4
Lakandula	"	21	40	61	0.5	0.3
Mileguas	"	17	21	38	0.8	0.5
Londres	"	20	17	37	1.2	0.5
Favoritos de J. Sta. Marina	"	21	41	62	0.5	0.3
Alhambra, 1st	"	23	19	42	1.2	0.5
Alhambra, 2nd	"	17	32	49	0.5	0.3
Alhambra, 3rd	"	23	22	45	1.0	0.5
H_3 (cured 1 year)	"	29	26	55	1.1	0.5
I_7 (cured 1 year)	"	18	16	34	1.1	0.5
I_9 (cured 1 year)	"	28	25	53	1.1	0.5

A SUMMARY OF STUDIES ON THE DEPTH OF IRRIGATION WATER FOR LOWLAND RICE IN WESTERN LAGUNA[1]

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WITH ONE PLATE

It is known that the depth of irrigation water used in the Philippines for any one variety of rice varies in different regions. Also, that variations occur from field to field; that one farmer differs from another in his experience as to the depth of irrigation water necessary to grow his crop. And furthermore it is known that there are different depths for different varieties according to the common practice.

In the College of Agriculture, seven studies were carried in six different years on farms in western Laguna to determine the depth of the irrigation water from the preparation of the field for rice to the harvest of the crop. In these studies, there was no attempt whatever to control the amount of water used. The study is mainly the finding of the actual depth of irrigation water used by the farmers in their fields, which they had found to be a good practice.

The present paper is a presentation of some of the results found in these seven studies.

REVIEW OF PREVIOUS WORK

Robertson (1917) found that 30 days after emergence of the plant was about the best time for beginning submergence. He also found that 6 inches (15.2 centimeters) was about the best depth of submergence. That where no water was held on the land the yield and quality were very poor.

Adams (1920) reported results of his investigation on the effect of the depth of water on the yield of rice in California. In his study, however, the amount of water used was directly controlled by him. His methods were different from those used by Filipino farmers.

[1]Experiment Station contribution No. 590.

This paper is in the main a discussion of data presented in a special problem assigned in Agricultural Engineering and in six theses presented for graduation from the College of Agriculture. These theses are: thesis No. 284 by Eusebio A. Bataclan; thesis No. 285 by Cipriano P. Barbon; thesis No. 286 by Leopoldo J. Villanueva; thesis No. 287 by Cipriano B. Cayabyab; all prepared in the Department of Agricultural Engineering, the first three under the direction of Assistant Professor Anastacio L. Teodoro, and the last one under the direction of Assistant Professor Felix D. Maramba. Thesis No. 288 by Constancio T. Medrana; and thesis No. 289 by Hermenigildo G. Protacio were prepared in the Department of Agronomy under the direction of Assistant Professor Mariano B. Raymundo. The titles of these theses appear under "Literature Cited".

Ricafrente (1921) performed an experiment in the College of Agriculture on the effect of varying depth of submergence on the yield of grain of variety Macan Piña in plots. He found that a continuous supply of water 10 centimeters deep was the best when the water was allowed to pass continuously through the paddy throughout the growing period of the rice. He also found that a supply of 20 centimeters deep gave the highest yield both in grain and straw, while a supply 3 centimeters deep gave the lowest yield. Under the conditions of his study, he concluded that if a supply 20 centimeters deep was allowed to flow through the paddy during the growing period the maximum yield in grain to the hill would be obtained.

From 1914 to 1921, studies were undertaken at the Biggs Rice Station, at Biggs, California, on the culture of lowland rice. Jones (1923) reports that a heavy yield was obtained by submerging the land about 6 inches (15.2 centimeters) during the submergence period. Also that the slowly changing water gave a higher average yield than where the water was stagnant. Another finding was that the fluctuation in the depth of submergence was very much better than slowly changing or stagnant water. Jones concluded that for best irrigation practice the field should be irrigated as often as necessary until 30 days after emergence, and then the land should be submerged 6 inches (15.2 centimeters) continuously until the crop is ready to drain for harvest.

MATERIALS AND METHODS

Fields

For the purpose of this paper, the fields used in the studies are lettered. Fields designated with B, as B-1 etc., are fields in Biñang, Laguna. Those designated as Ca are in Calamba, Cn in Calauan, and R in Santa Rosa, Laguna.

Fields were used at different times in the study, and for this paper carry different designations. (See table 1). Investigations on fields B-1 to B-3 were undertaken by Protacio (1928) in the season from July 1926 to January 1927. Investigations on fields Ca-1 and Ca-2 were made by Barbon (1925) during the season from November 1924 to March 1925. Fields Ca-3 and Ca-4 were studied by Español[2] during the season from November 1925 to February 1926. Data for fields Cn-1 to Cn-7 were obtained by Bataclan (1924) during the season from May to October 1923. Fields Cn-8 to Cn-13 were studied by Villanueva (1925) from June to November 1924. Data on fields Cn-14 to Cn-16 were obtained by Cayabyab (1928) from August 1927 to February 1928. Studies on fields R-1 to R-3 were

[2] The relation between the yield of lowland rice and the depth of irrigation water as practiced by two farmers of Calamba, Laguna, Philippine Islands. (A special problem assigned to Filemon E. Español in the Department of Agricultural Engineering under the direction of Assistant Professor Anastacio L. Teodoro, last part of study under Assistant Professor Felix D. Maramba. 1927.)

made by Medrana (1927) during the season from July 1926 to January 1927.

Table 1 gives a description of the kind of soil in each field. The Biñang fields are of clay loam. The Santa Rosa fields are also of the clay loam type. The soil of Calamba fields was not determined in the work undertaken there; it may be presumed, however, that the Calamba soil is of the clay loam type, as it is in a clay loam region. The Calauan soils were found to be of the clay loam type and as a rule rather high in organic matter.

Varieties of rice

In Biñang, the variety of rice used was Inadhika[3]. The seedlings were planted in the field at about 15 to 20 centimeters apart. In Santa Rosa, the varieties used were Macan and Nagsalit. Macan was planted in the field about 20 centimeters apart, and Nagsalit about 25 centimeters. The variety used in Calamba is known as Mangasa. When not broadcasted, the seedlings were planted about 25 centimeters apart. Three varieties of rice were used in Calauan: Binicol, Binangbang-puti, and Guinangang. For any variety, the practice in Calauan is to set the plants about 15 to 20 centimeters apart.

Method of irrigation

The check method of flooding is the type of irrigation practiced in these fields. The water is applied intermittently, hence there are periods when the fields are dry during the growth of the crop.

Stagnation of water is seldom used. The farmers apparently prefer the slow flowing water in flooding the checks.

Preparation of the paddies

About five to nine weeks before planting, the fields were prepared. They were flooded and soaked for a day or so before plowing, which was to a depth of about 20 to 25 centimeters. After plowing, the fields were harrowed.

Harrowing was done with the native harrow called *suyod*. The harrowing was first in one direction and then in a cross direction for three or four times. It appears that the farmers determine the number of harrowings needed by the condition of the fields. If the field has quite a number of heavy clods after the third harrowing then a fourth is necessary.

Seed bed and seedlings

As the amount of water used in the preparation of the seed bed and in the treatment of the seeds is negligible, this phase of the rice cultivation is not given in this paper.

[3] The variety names given in this paper are the common names in the Tagalog dialect.

Water gauge

The depth of water in the fields was measured by means of a simple water gauge which consists of a reference stake and a guide stake. The reference stake is driven flush to the surface of the field. To locate this stake easily, the guide stake is set by it. The depth of water is obtained by measuring the distance from the top of the reference stake to the surface of the water. A meter stick can be used for this.

These water gauges are set about five meters from the inlet and outlet of each paddy.

DISCUSSION OF RESULTS

Field preparation

Table 2 shows the average depths of water used in the preparation of the fields. It may be seen in this table that in the preparation of the fields the average depth of water was 11.1 centimeters. The deepest application of water was right after plowing; and the fields were all prepared with only three harrowings.

The time it took to prepare the fields varied from five to nine weeks. The actual irrigation of the fields during the preparation varied from 7 to 60 days, as may be seen in table 5. The average number of irrigation days was 44; in other words, the field was under water for 44 days during the preparation. This practice is quite common in the towns under consideration.

Irrigation of crop

The irrigation of the crop is the phase that is the most important. The fields, from the very day the plants were transplanted, were under the influence of water. Table 3 shows the average weekly measurements of the depth of water in each field from transplanting to the harvest of the crop. It will be seen that the average depth of irrigation water varied in the different fields. It will be noted that the maximum average depth of water was in field Cn-3 with the Guinangang variety; and the minimum average depth in field R-1 wih the Nagsalit variety. Table 4 shows the maximum and minimum depths of irrigation water and the time it was applied.

From table 5 it may be readily seen that of the seven varieties used, Inadhika had the highest average maximum depth of irrigation water; and Macan the lowest minimum depth.

The averages here presented are not as they should be for the number of individual variety tests are not the same. However, they are a fair criterion. From the data, it may be seen that Binicol and Guinangang are the heaviest users of irrigation water. Named from the lowest minimum average to the highest, the varieties are, Macan, Binangbang-puti, Inadhika, Nagsalit, Mangasa, Guinangang, and Binicol. Naming from the

highest maximum average to the lowest, the varieties are, Inadhika, Binicol, Mangasa, Guinangang, Binangbang-puti, Nagsalit, and Macan.

Table 5 further shows that the fields for Binangbang-puti had an average of 53 irrigation days during preparation; Mangasa had 50; Nagsalit, 48; Binicol, 43; Guinangang, 42; Inadhika, 41; and Macan, 7. Nagsalit had 123 irrigation days from transplanting to harvest; Binicol had 115; Inadhika, 110; Guinangang, 109; Mangasa, 108; Binangbang-puti, 107; and Macan, 102. From these figures it can be found that the average irrigation days during preparation of fields was about 41 days, and during the growth of any variety about 111 days.

Probable irrigation curves

From the data here presented, the writer has worked out some interesting curves which he calls the "probable irrigation curves." (See plate I.)

The curves are generally all three-period curves. The short maturing crops, Macan and Mangasa, are the only two-period curves. Even these, however, show a tendency to the three-period curve, as undoubtedly would have been the case if the crops had matured later.

These curves show that the intermittent method of irrigation is the common practice in these fields. They further show that the heaviest irrigation is towards the maturity of the crop.

From the individual crop curves, the last curve was developed. This curve is the probable curve for any variety of rice.

These curves show that with any of these varieties if irrigation followed the particular curve, or the relative curve, a fair result would be obtained.

Yields

The yield obtained from each field is shown in table 6. From this table it is evident that Binangbang-puti, Nagsalit, Mangasa, and Guinangang are heavy producers in the order named; and Macan, Inadhika, and Binicol, low producers in the order named. The highest yield was that of field Cn-2, Guinangang, with 63.1 cavans; the lowest was from field R-2, Macan, with 17 cavans.

SUMMARY AND CONCLUSIONS

1. The soils of rice fields in Biñang, Calamba, Calauan, and Santa Rosa, Laguna Province are of the clay loam type.

2. The average depth of irrigation water used during the preparation of the fields was 11.1 centimeters.

3. There was an average of 44 days of irrigation during the preparation of the fields. The deepest irrigation during preparation was after plowing.

4. The average time for maturing of crop was from 12 to 13 weeks for the short-maturing varieties; and 16 to 17 weeks for the long-maturing.

5. The average depth of irrigation water used for each variety was: Binangbang-puti, 6.2 centimeters; Binicol, 12.3; Guinangang, 10.1; Inadhika, 9.3; Macan, 2.9; Mangasa, 9.0; Nagsalit, 2.6. The average depth was 7.5 centimeters.

6. The average yields by variety were: Binangbang-puti, 58.2 cavans; Nagsalit, 56.0; Mangasa, 50.9; Guinangang, 49.5; Binicol, 40.9; Inadhika, 33.9; Macan, 17.0.

7. The probable irrigation curves for each variety are good guides for the irrigation of the crop.

8. The probable irrigation curve for any variety is a guide which may give a fair result for any crop irrigated according to it.

9. Studies should be carried on for some time to get the best irrigation curves.

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TABLE 1

Showing area and kind of soil of each field

FIELDS AND OPERATORS[b]	AREA	KIND OF SOIL[a]	
		Surface layer, 0 to 30 cm.	Sub-surface layer, 30 cm. and below
	Ha.		
B–1 Dikes Carlit	4.3374	Dark grayish brown, light silty clay loam.	Dark brownish gray silty clay loam.
B–2 Anacleto Tana	4.0498	Dark gray clay loam mottled with brown specks.	Dark grayish brown clay loam, with large amount of tuff fragments.
B–3 Benedicto Casaysayan	2.3596	Dark gray mottled silty clay loam.	Silty clay loam, mottled gray and brown.
Ca–1 Felix Cahanap	1.399	(No determination).	(No determination).
Ca–2 Francisco Manalo	1.508	(No determination).	(No determination).
Ca–3		(Same field as Ca–1).	(Same field as Ca–1).
Ca–4		(Same field as Ca–2).	(Same field as Ca–2).
Cn–1 Francisco Carreon	1.0498	Deep chocolate brown (as a moist hand sample), clay loam.	Dark gray to nearly black, somewhat mottled, (as a moist hand sample); medium heavy clay loam.
Cn–2 Isidoro Carinio	0.9602	Deep chocolate brown (as a moist hand sample), clay loam.	Gray to nearly black. Clay loam.
Cn–3 Anselmo Maletic	1.0707	Medium gray mottled clay loam, with some gravel and considerable organic matter.	Gray mottled clay loam with some gravel and some organic matter.
Cn–4 Salustiano Maletic	3.2123	Dark gray mottled with some brownish spots, silty clay loam. Some organic matter.	Dark gray mottled with loam, light clay loam. Some organic matter.
Cn–5 Vicente Belen	1.1144	Medium dark gray, light silty clay. High in organic matter.	Dark gray silty clay loam. Considerable organic matter.
Cn–6 Vicente Esguerra	1.8440	Dark gray to dark brownish gray mottled with brownish spots. Light silty clay loam.	Mottled dark brown with light yellowish and grayish color. Loam.
Cn–7 Marasigan and Ramos	2.9547	Brownish gray. Silty clay loam.	Grayish brown. Clay loam.
Cn–8		(Same field as Cn-6).	(Same field as Cn–6).
Cn–9 Marcelo Aguaraz	2.0100	Deep chocolate brown (as a moist hand sample), clay loam.	Dark gray to nearly black, somewhat mottled medium heavy clay loam.
Cn–10		(Same field as Cn–7).	(Same field as Cn–7).
Cn–11 Isidro Carinio	2.4240	Dark gray, mottled with some brownish spots, silty clay loam. Some organic matter.	Dark gray, mottled with loam, light clay loam. Some organic matter.
Cn–12		(Same field as Cn–5).	(Same field as Cn–5).

Cn–13..... Pio Bandala	1.9027	Medium gray, mottled clay loam, with some gravel and considerable organic matter.	Gray, mottled, with loam. Clay loam with some gravel and some organic matter.
Cn–14..... Marcelo Aguaraz	5.1250	Brown, mottled light brown clay loam.	Mottled clay, brownish gray clay loam.
Cn–15.....		(Same field as Cn–11).	(Same field as Cn–11).
Cn–16.....		(Same field as Cn–7).	(Same field as Cn–7).
R–1..... Melecio Carta	3.3120	Medium light brownish gray clay loam.	Grayish brown clay loam with fragments of tuff.
R–2..... Melecio Carta	1.4949	Gray clay.	Brown clay loam with fragments of tuff.
R–3..... Benito Guerta	3.7855	Dark bluish gray.	Bluish gray to medium brown gray, heavy clay loam

[a] Soils were classified by Dr. Robert L. Pendleton of the Soils Division, College of Agriculture, University of the Philippines.

[b] Fields designated as *B* are in Biñang; *Ca*, in Calamba; *Cn*, in Calauan; and *R*, in Santa Rosa.

TABLE 2

Showing the average depth of water in each field during its preparation

FIELDS[a]	PLOWING		HARROWING							AVERAGE
	Before and during	After	1st	After 1st	2nd	After 2nd	3rd	After 3rd	4th	
	cm.	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
B–1	7.6	25.2	——	12.7	——	13.9	——	15.2	——	14.9
B–2	6.3	30.0	——	12.7	——	10.1	——	15.2	——	14.9
B–3	5.7	29.0	——	10.0	——	9.5	——	7.0	——	12.2
Ca–1	6.7	7.0	——	8.4	——	11.2	——	5.5	——	7.8
Ca–2	6.8	6.1	——	5.9	——	12.3	——	5.4	——	7.3
Ca–3	6.8	6.7	——	8.4	——	8.8	——	——	——	7.7
Ca–4	7.2	5.0	——	12.3	——	5.2	——	——	——	7.4
Cn–1	8.9	15.9	16.5	15.2	10.2	16.5	11.4	16.5	——	13.9
Cn–2	7.2	16.5	17.8	17.8	10.8	15.2	8.9	17.8	——	14.1
Cn–3	8.9	15.9	19.0	15.9	14.4	17.8	8.9	12.6	——	14.4
Cn–4	5.1	16.5	16.5	19.1	12.7	16.5	12.7	19.1	——	14.8
Cn–5	9.5	17.8	22.9	20.3	7.6	17.8	9.5	19.7	——	14.4
Cn–6	8.3	17.1	17.2	15.2	9.5	17.8	12.7	21.0	——	14.8
Cn–7	7.3	17.2	17.9	17.9	11.4	15.9	8.9	16.5	——	14.1
Cn–8	4.3	16.5	12.3	18.3	10.7	23.6	4.3	——	——	12.9
Cn–9	6.8	12.3	9.5	20.2	8.2	19.7	8.8	5.1	3.6	10.5
Cn–10	4.2	12.6	13.2	17.2	11.2	20.5	7.2	6.4	2.3	10.6
Cn–11	5.3	15.3	12.3	21.4	8.2	16.7	4.0	——	——	11.9
Cn–12	7.1	15.3	8.5	17.7	6.8	16.5	4.1	——	——	10.9
Cn–13	6.1	10.2	16.2	15.5	10.2	13.7	4.2	——	——	10.9
Cn–14	10.7	4.6	9.4	3.0	9.1	2.2	4.5	.3	——	5.5
Cn–15	9.1	3.5	11.7	4.2	13.5	3.3	14.4	3.0	——	7.8
Cn–16	8.2	5.5	14.1	4.2	14.7	3.5	14.1	2.8	——	8.4
R–1	9.4	——	14.4	——	4.5	4.0	1.6	——	——	6.8
R–2	9.4	——	12.7	——	12.0	12.0	1.9	——	——	9.6
R–3	8.0	——	16.8	——	17.0	13.7	1.1	——	——	11.3

[a] *B* are in Biñang; *Ca*, in Calamba; *Cn*, in Calauan; and *R*, in Santa Rosa.

TABLE 3

Showing average depth of water in each field during the growth of the crop up to draining for harvest

AVERAGE WEEKLY MEASUREMENTS OF DEPTH IN CENTIMETERS														AVERAGE
5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	
														cm.
2.5	7.7	5.1	2.5	9.8	12.0	15.3	14.4	1.4	16.9	17.5	17.5	drained	——	8.5
1.8	2.9	5.0	2.0	11.0	13.4	14.6	16.9	16.7	17.0	17.5	15.8	drained	——	9.3
1.5	6.5	7.6	.7	8.0	14.3	16.7	16.5	17.7	16.9	17.2	16.7	drained	——	10.0
11.8	——	6.0	9.8	15.5	8.5	6.1	6.5	drained	——	——	——	——	——	8.8
12.6	12.6	——	6.9	8.9	9.0	15.3	7.1	4.8	drained	——	——	——	——	9.1
5.1	6.8	2.5	1.9	1.0	2.4	1.3	1.6	drained	——	——	——	——	——	3.4
4.8	8.3	4.8	3.4	1.7	2.3	1.9	1.9	drained	——	——	——	——	——	3.9
14.0	16.2	——	——	——	——	15.2	15.2	15.2	——	15.2	drained	——	——	12.6
14.7	14.7	——	——	——	——	15.9	15.9	15.9	——	17.2	drained	——	——	13.1
15.9	——	——	——	——	17.8	17.8	17.8	17.8	——	17.8	17.8	17.8	drained	15.4
13.3	14.7	——	——	——	16.5	16.5	16.5	——	16.5	16.5	16.5	16.5	drained	14.1
14.7	——	——	——	——	——	17.8	17.8	——	17.8	17.8	17.8	17.8	drained	14.9
16.5	——	——	——	——	17.2	17.2	17.2	——	17.2	17.2	17.2	17.2	drained	15.2
15.2	15.9	——	——	——	——	14.0	14.0	——	14.0	14.0	14.0	14.0	drained	12.9
——	——	7.2	7.2	7.2	7.2	7.2	7.2	7.2	drained	——	——	——	——	7.3
8.0	——	5.2	5.2	5.2	5.2	6.3	6.3	drained	——	——	——	——	——	6.0
7.3	6.1	——	——	8.1	9.2	drained	——	——	——	——	——	——	——	9.4
——	——	14.6	——	——	5.1	5.1	drained	——	——	——	——	——	——	7.5
——	16.1	——	——	14.3	drained	——	——	——	——	——	——	——	——	11.2
11.6	——	——	12.6	——	9.7	9.7	drained	——	——	——	——	——	——	9.8
.1	10.9	.6	12.6	.2	6.7	8.9	——	8.3	5.1	drained	——	——	——	6.2
5.1	15.3	2.1	11.8	.7	5.9	——	12.1	——	5.4	drained	——	——	——	7.8
13.2	.7	17.0	.4	15.5	10.9	3.6	14.0	3.1	4.2	drained	——	——	——	7.9
——	——	——	1.9	1.8	2.9	2.6	3.5	1.6	.1	.6	drained	——	——	2.5
——	——	1.1	.5	.4	3.3	4.8	5.4	drained	——	——	——	——	——	2.9
——	——	3.6	——	——	3.3	1.1	2.2	——	2.3	2.2	1.8	drained	——	2.7

lauan; and *R*, in Santa Rosa.

FIELDS[a]	1st	2nd	3rd	4th
B–1.....	5.0	5.4	2.3	.4
B–2.....	5.8	5.7	1.8	.4
B–3.....	5.9	6.2	3.8	3.8
Ca–1.....	3.9	7.2	11.1	10.3
Ca–2.....	3.1	6.1	10.8	11.8
Ca–3.....	5.9	3.8	4.5	4.1
Ca–4.....	6.6	2.8	4.1	4.5
Cn–1.....	7.0	7.0	8.9	12.1
Cn–2.....	6.4	7.0	9.5	13.3
Cn–3.....	9.5	9.5	12.1	12.7
Cn–4.....	7.0	8.9	10.8	12.7
Cn–5.....	7.0	9.9	12.1	13.3
Cn–6.....	7.0	9.5	13.3	15.9
Cn–7.....	5.7	8.9	——	12.1
Cn–8.....	2.2	8.7	12.6	6.3
Cn–9.....	2.8	——	10.3	5.7
Cn–10.....	4.2	13.3	16.6	10.4
Cn–11.....	3.2	9.7	——	——
Cn–12.....	2.7	——	10.2	12.6
Cn–13.....	2.0	——	13.1	——
Cn–14.....	.5	3.9	8.9	13.6
Cn–15.....	1.2	4.4	14.1	14.7
Cn–16.....	.1	5.1	6.8	16.1
R–1.....	——	5.2	3.2	3.4
R–2.....	——	4.3	3.5	2.9
R–3.....	6.6	.8	——	——

[a] *B* are in Biñang; *Ca*, in Calamba; *Cn*, in Ca

TABLE 4

Showing minimum and maximum depths of irrigation water and the stages of plant growth when applied

FIELDS[a]	MINIMUM	WEEK AFTER PLANTING	MAXIMUM	WEEK AFTER PLANTING	VARIETIES
	cm.		*cm.*		
B–1	.4	4th	17.5	15th	Inadhika
B–2	.4	4th	17.5	15th	"
B–3	.7	8th	17.7	13th	"
Ca–1	3.9	1st	15.6	9th	Mangasa
Ca–2	3.1	1st	15.3	11th	"
Ca–3	.9	9th	5.9	1st	"
Ca–4	1.7	9th	6.6	1st	"
Cn–1	7.0	1st	16.2	5th	Guinangang
Cn–2	6.4	1st	17.2	16th	"
Cn–3	9.5	1st	17.8	13th	"
Cn–4	7.0	1st	16.5	12th	Binicol
Cn–5	7.0	1st	17.8	12th	"
Cn–6	7.0	1st	17.2	12th	"
Cn–7	5.7	1st	15.9	6th	"
Cn–8	2.2	1st	12.6	4th	"
Cn–9	2.8	1st	10.3	3rd	Guinangang
Cn–10	4.2	1st	16.6	3rd	Binicol
Cn–11	3.2	1st	14.6	7th	Guinangang
Cn–12	2.7	1st	16.1	6th	"
Cn–13	2.0	1st	13.1	3rd	"
Cn–14	.5	1st	8.9	3rd	Binangbang-puti
Cn–15	1.2	1st	14.4	3rd	Guinangang
Cn–16	.1	1st	14.7	7th	"
R–1	.1	13th	5.2	2nd	Nagsalit
R–2	.4	8th	5.4	12th	Macan
R–3	.8	2nd	6.6	1st	Nagsalit

[a] *B* are in Biñang; *Ca*, in Calamba; *Cn*, in Calauan; and *R*, in Santa Rosa.

TABLE 5

Showing the average depth of water and number of irrigation days for each variety

VARIETIES	AVERAGE			IRRIGATION DAYS:		YIELD PER HECTARE
	Minimum	Maximum	Depth	during preparation	during crop growth	
	cm.	*cm.*	*cm.*	*average*	*average*	*cavans*
Binangbang-puti	.5	8.9	6.2	53	107	58.2
Binicol	5.5	16.1	12.3	43	115	40.9
Guinangang	3.9	14.9	10.1	42	109	49.5
Inadhika	.5	17.6	9.3	41	110	33.9
Macan	.4	5.4	2.9	7	102	17.0
Mangasa	3.5	15.5	9.0	50	108	50.9
Nagsalit	.5	5.9	2.6	48	123	56.0

TABLE 6

Summary

FIELDS [a]	IRRIGATION: during preparation		IRRIGATION: during the growth of the crop				TOTAL DAYS FIELD WAS IRRIGATED	YIELD PER HECTARE	VARIETIES
	Days irrigated	Average depth	Days drained	Days submerged	Days irrigated	Average depth			
		cm.				*cm.*		*cavans*	
B–1	41	14.9	20	90	110	8.5	151	29.5	Inadhika
B–2	41	14.9	15	95	110	9.3	151	35.5	"
B–3	41	12.2	14	96	110	10.0	151	37.0	"
Ca–1	50	7.8	15	93	18	8.8	158	51.5	Mangasa
Ca–2	50	7.3	15	93	108	9.1	158	50.3	"
Ca–3	49	7.7	14	69	83	3.4	132	?	"
Ca–4	49	7.4	14	69	83	3.9	132	?	"
Cn–1	38	13.9	52	64	116	12.6	154	57.3	Guinangang
Cn–2	38	14.1	52	64	116	13.1	154	63.1	"
Cn–3	38	14.4	57	59	116	15.4	154	55.0	"
Cn–4	48	14.8	60	57	117	14.1	165	47.2	Binicol
Cn–5	42	14.4	64	52	116	14.9	158	41.3	"
Cn–6	47	14.8	60	57	117	15.2	164	44.4	"
Cn–7	45	14.1	54	61	115	12.9	160	40.6	"
Cn–8	39	12.9	49	64	113	7.3	152	34.2	"
Cn–9	38	10.5	53	57	110	6.0	148	60.7	Guinangang
Cn–10	34	10.6	84	26	110	9.4	144	36.9	Binicol
Cn–11	46	11.9	83	28	111	7.5	157	38.4	Guinangang
Cn–12	34	10.9	87	25	112	11.2	146	35.9	"
Cn–13	42	10.9	84	31	115	9.8	157	42.6	"
Cn–14	53	5.5	43	64	107	6.2	160	58.2	Binangbang-puti
Cn–15	52	7.8	31	60	91	7.8	143	42.8	Guinangang
Cn–16	53	8.4	40	56	96	7.9	149	49.5	"
R–1	35	6.8	70	59	129	2.5	164	59.0	Nagsalit
R–2	7	9.6	52	50	102	2.9	109	17.0	Macan
R–3	60	11.3	61	56	117	2.7	177	53.0	Nagsalit

[a] *B* are in Biñang; *Ca*, in Calamba; *Cn*, in Calauan; and *R*, in Santa Rosa.

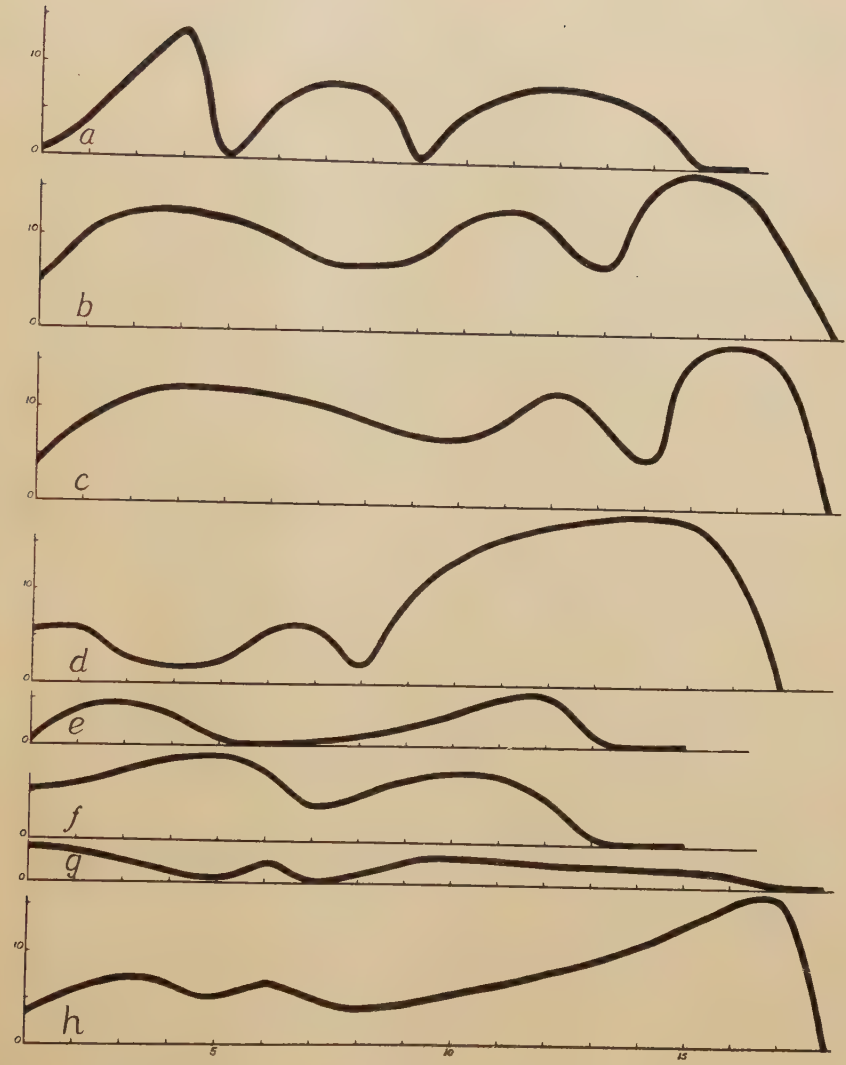

Plate I

Probable irrigation curves for a few varieties of lowland rice in Biñang, Calamba, Calauan, and Santa Rosa, Laguna.

a.—Binangbang-puti; *b.*—Binicol; *c.*—Guinangang; *d.*—Inadhika; *e.*—Macan; *f.* Mangasa; *g.*—Nagsalit; and *h.*—for any variety (a general curve developed from the curves *a*, *b*, *c*, *d*, *e*, *f*, and *g*).

Vertical axis represents depths in centimeters, and horizontal axis represents weeks.

A PROMISING CASSAVA GRATER FOR THE FARM[1]

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WITH TWO TEXT FIGURES

The need for a portable and at the same time an efficient cassava grater on the farm, especially where cassava is raised as an important part of the food stuff is obvious. This condition exists in many parts of Mindanao and other regions of the Philippines. Furthermore, an efficient cassava grater or crusher would encourage cassava cultivation as the machine would be of great help to the farmers in converting their cassava crop into utilizable forms, such as cassava meal, flour, and starch. If a farmer had a grater the cassava crop would not be left in the fields waiting for market for the fresh product, a practice that causes a loss of crop through decay or through woody formation in the old roots.

With these conditions in view, the writer attempted to devise what he hopes will be a useful cassava grater for the farm. The machine may be useful in preparing fresh storage roots other than cassava into meal which can be used for immediate feeding, for drying, and for flour making.

REVIEW OF LITERATURE

In the Philippines little has been written on cassava graters. Copeland (1908) mentions that ordinary thin sheets of galvanized iron or cut sheets from tin cans in which holes had been punched were used by the Filipinos in making cassava meal by rasping. A machine operated on the same principle (rasping) was constructed some years ago by Prof. Harold Cuzner then in this College, but this machine is primarily for the extraction of starch, and is run by motor. A figure used by Blokzeijl (1922) in his book, *De Cassave* shows similar appliances used in some cassava starch factories in Java. In South America where, according to Nichols (1920), the preparation of the meal from cassava is on a comparatively large scale, the grating is done in most cases by rasping, a process identical to that used in Java and in Cuzner's machine. It may be of interest to quote the following from Nichols on this subject:

> The natives fix a large grater against a tub, and leaning over it with tubers in each hand, they grate quickly and rhythmically to the sound of a drum and they are encouraged to extra exertions by the stimulating influence of inspiriting local songs. . . . . .

[1]Experiment Station contribution No. 591 Received for publication October 9, 1928.

The writer wishes to acknowledge the help extended by Prof. M. B. Raymundo through the use of the Agronomy Blacksmith Shop. Thanks are also due to Dr. N. B. Mendiola for suggestions and to Dr. T. Vibar for his encouragement in the construction of the machine.

Obviously it is a laborious task to grate cassava with such simple and crude appliances. Also it is very slow work as one can grate only about four kilograms of cassava an hour. In addition to its being slow and hard work the grated material may not be very appetizing for food owing to dirt and peeling getting in during the grating. In figure 1, are shown two typical native graters (2) and (3) formerly used in this College in the production of cassava meal.

Fig. 1.—Some of the native tools (2) and (3) used in grating cassava compared with the portable cassava grater. Each is operated by one man power.

DESCRIPTION OF GRATER

In the construction of the Cassava grater the following materials were used:

2 pcs. of board 10′×1″ @ ₱0.10	₱ 2.00
1 pc. for legs 12′×3″×3″	0.30
1 pc. for beams 1″×4″×3″	0.50
1 pc. yacal for the axle	0.20
4/5 galvanized iron roofing plain @ ₱2.10	1.60
3 bolt 3″×1/4″	0.06

1 hinge	0.20
6 screws @ P0.01	0.06
2 iron tires @ P0.50	1.00
Cost of material	P 5.92
Cost of labor for construction @ P1.50 for 12 days	18.00[2]
Total cost of construction	P23.92

Fig. 2.—Side view of the grater showing (*a*) feeder; (*b*) lever; (*c*) pedal and (*d*) box containing grated cassava.

Before the construction of the grater, trials were made on the size of the holes that were to be made in the blades. Two sizes were used, one 1.5 mm. in diameter and the other is 2.5 mm. The 2.5 mm. holes were found to grate the faster. But it was finally decided to use both sizes of holes, one on each blade.

The wheel is in the form of a drum 36 cm. in diameter, with two circular boards an inch in thickness as sides. A hole 6 cm. square was made in the middle of each board through which the axle was put. The sides

[2] The carpenter who was employed to construct this device says that the cost of construction can be reduced to ₱15.00.

of the drum were then nailed to this axle, after which a sheet of plain galvanized iron was nailed around the sides to prevent water or grated material from getting into the drum.

The blades are of plain galvanized iron circular in shape and 60 cm. in diameter. On one, 6 rows of holes 2.5 mm. in diameter and arranged in quincunx were made, and on the other, 8 rows of 1.5 mm. holes. These holes were made by driving a sharpened nail through the marked points. To prevent the blade from wrinkling as the holes were being made the blade was laid flat on a piece of board. As soon as the nail went through, the blade was lifted so as to allow the bending of the nail thus making all the holes slant in same direction. This slanting of the edges of the holes is necessary to make a surface that will grate.

To give strength to the blades, circular frames were made out of wood and reinforced with iron tires. The blades were then nailed to the frames and the central portion was cut out leaving a blade 15 cm. wide all around. The blades were then attached to the drum, one on each side.

The box and the stand were next made and on each side a feeder was provided. To operate the grater with the feet a lever, the principle of which is that of the sewing machine treadle was attached to it. Figure 2 shows the device as completed when tested February 14, 1928; figure 1 shows the grater compared with native graters. As can be seen each is operated by one person.

RESULTS OF TRIALS

In the first trial made it was found that the machine grated 15 kilograms in 35 minutes or at the rate of about 27 kilograms an hour. In this trial only the blade with the larger sized holes was used. In the second trial made on February 14, the blade with the smaller holes was used and a rate of 23 kilograms an hour was obtained. On February 16 some 102 kilograms of grated cassava was needed in the Experiment Station and the machine was used. According to the *capataz* under Prof. M. B. Raymundo who supervised the work at the time it took about four hours for the laborer to grate all the cassava needed. On an average, therefore, the grater can grate 25 kilograms an hour. The results of the three trials made are tabulated below:

DATE	TIME SPENT	ACTUAL AMOUNT GRATED	COMPUTED RATE PER HOUR	AVERAGE RATE PER HOUR
	Hr. *Min.*	*Kgm.*	*Kgm.*	*Kgm.*
Feb. 11, 1928	— 35	15	27	—
Feb. 14, 1928	1 —	22	22	25
Feb. 16, 1928	4 —	102	25.5	—

The 102 kilograms grated on February 16, 1928 would have cost the College some ₱0.40 for the labor at the wage rate of 10 centavos an hour. Had the native graters been used, with which according

to trials made the same day a laborer could grate about 4 kilograms an hour, this quantity (102 kgm.) of grated cassava would have cost for the labor alone ₱2.50. The saving in labor was easily ₱2.10.

Although it is hoped that the grater can be improved and be made of material such that it can be hitched to a horse power engine, for ordinary farm use the wooden machine will answer. The feeder, however, can be made larger so that the ordinary large storage roots of cassava or of other root crops need not be cut into small pieces to fit the feeder.

The machine may also be used to grate root crops which are chopped or sliced and dried for future use. For hog and for poultry raisers who may use cassava or other root crops as part of rations the machine would be very helpful in the preparation of the meal, either for immediate feeding or for drying for future use. Flour is casily made from the meal produced by this grater.

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ZACATE AND WATER CONSUMPTION OF PHILIPPINE HORSES[1]

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Zacate, or cut green forage given to animals, known among American farmers as soilage, is the only roughage supplied to stable horses in the Philippines. This limitation in roughage is principally because these soiling crops are healthful and have a high nutritive value and there is a lack of cheap hay materials in the Islands. For economic and other reasons, it is important, then, that the capacity of Philippine horses for soilage be known.

The role water plays in carrying on the vital processes in the animal body is well known. So it is also important that knowledge of the quantity of water consumed by Philippine horses be made available.

OBJECT

The experiments reported in this paper were undertaken to determine the soilage and water consumption of Philippine horses and its relation to the weight of the animals.

TIME AND PLACE

The work was conducted at the College of Agriculture, University of the Philippines.

The first set of the experiments on soilage consumption was carried on from October, 1922, to April, 1923, covering a period of seven months. Later trials on soilage and water consumption were made from November, 1927 to November 1928, or a period of one year.

HORSES

Ten horses were used in this experiment, consisting of four geldings, four stallions, and two mares. Six are of native blood. Of the other four, Councilor and Queen possess Welsh blood, Prince is with Arabian infusion and Licus is an American grade. The range in age was from 3 to 10 years at the beginning of the tests, their average age being 7.9 years. None of the animals was too old to make use of its teeth to properly masticate its feed. The average height is 126 cm. The weights given are the averages of the weekly weights throughout the period of experiments. The general average is 231.2 kgm. the lightest horse weighing 176.4 kgm. and the heaviest 253.1 kgm. (see table 1).

[1]Experiment Station contribution No. 592 Received for publication December 3, 1928.

All horses were worked now and then for riding or driving in a calesa. This work was light and served to exercise and maintain the health of the animals, Councilor and Licus were put to hard labor occasionally.

TABLE 1

Showing the breed sex, age, height, and weight of horses

HORSES	BREED	SEX	AGE	HEIGHT	AVERAGE WEIGHT
			year	*cm.*	*kgm.*
Service	Native	Gelding	10	128.0	244.0
Monday	Native	Gelding	10	131.0	252.2
White	Native	Gelding	9	114.0	176.4
Licus	American grade	Stallion	9	129.0	253.1
Councilor	Welsh grade	Gelding	6	129.0	229.7
Sultan	Native	Stallion	15	129.5	234.6
Luck	Native	Stallion	5	127.0	217.4
Prince	Arabian grade	Stallion	3	131.0	221.8
Capitana	Native	Mare	7	121.0	251.6
Queen	Welsh grade	Mare	4½	120.0	230.9
		Average	7.9	126.0	231.2

SOILAGE

Various kinds of soiling crops were used during the investigation. These include roughages which were available and ordinarily fed to stable horses in the College. The main portion of the soilage used consisted of Guinea grass and corn fodder. When these were not available Napier grass or cogon were used, especially during the dry season when the production of soilage is generally low.

One important criterion observed in the selection of forages before feeding them was the stage of development of the plants. In any case the grass was fed when neither too young to give very laxative effect on the animal nor too old and coarse to be unpalatable and probably constipating. With the corn plant this stage is between tasseling and glazing periods, although some times the plant was used when the kernels were at the milk stage. Guinea grass is generally most suitable for feeding when the inflorescence begins to show in the field. Napier grass is never too old to feed because the tops, consisting of the leaves and juicy stalk, are always tender enough for feeding, but very young new shoots of this grass are likely to give watery feces when taken in large amounts. Cogon was used when very young. This grass is never too young for feeding purposes. But it grows very rapidly and becomes fibrous rendering it unpalatable and low in nutritive value when old.

To lessen waste in the feeding of corn and Napier grass these feeds were always passed through a cutter reducing the stalks into sections of one-half of an inch in length so that both leaves and stalks are eaten by the horse.

WATER

Ordinary tap water from a mountain stream was used. In no case was any material such as common salt and molasses which may stimulate greater consumption of water used.

FEEDING, WATERING, AND MANAGEMENT

The horses were all given full feed. The first feeding was made at 6:30 a. m., the second at noon, the third at 3:00 p. m. and the fourth and last feeding at 6:30 p. m. As much roughage was placed in the manger each time as the animals would consume leaving only the rougher unpalatable parts of the feed uneaten. Whenever an animal got off its feed, consuming only a relatively small portion of the feed given, the appetite was stimulated back to normal by supplying very much less of the feed the next feeding time. The usual grain feed given to horses was furnished them.

In determining the consumption of soilage the weighings of the materials supplied to each horse during the day were recorded and totalled. The feed left in the manger was collected the next morning and weighed. The difference between the total weights supplied to each animal and that of the left-over represents the amount consumed during the test day.

Watering was done at the same time that the animal was given the soilage. Direct readings of the weights of water before and after each horse drank were made, the difference representing the amount consumed. The total weight of water consumed four times during the day gives the consumption for that day.

All the horses used in this investigation were placed in separate stalls in the daytime where they were given their feed and water. At eight o'clock in the evening they were placed in separate boxstalls well bedded with straw; here they could lie down and relax. A box was kept in the boxstall where salt was placed, thus supplying the horses this mineral at will. The horses were taken from the boxstalls and put in the stalls each morning at six o'clock.

The necessary care, that is, bathing, currying, and general cleaning was given to all animals under observation. The health and manner of feeding of the animals were noted so that any unusual behavior of any individual which might introduce error in the results was immediately remedied. For instance, if a work horse had undergone strenuous labor so that his feeding was slow and abnormal he was eliminated during that day from the group being tested. Such cases, however, were few.

With the test carried out with Service, Monday and White, determination of soilage consumption was made daily during the period of the experiment. With the rest of the animals the test was made one day each week throughout the year. With the weekly tests only a single kind of forage was used during each test day.

Water consumption was taken also once a week.

TABLE 2

Showing the average daily consumption of Guinea grass by Philippine horses at ten-day periods

TEN-DAY PERIOD	SERVICE	MONDAY	WHITE
	kgm.	*kgm.*	*kgm.*
First	13.3	15.2	10.8
Second	13.1	15.6	11.9
Third	14.6	16.7	14.5
Fourth	17.6	15.2	10.6
Fifth	16.8	15.1	12.5
Sixth	17.3	17.8	13.3
Seventh	——	16.9	13.5
Eighth	——	16.6	13.6
Ninth	——	16.7	13.4
Tenth	——	17.1	14.2
Eleventh	——	16.9	11.8
General average	15.5	16.3	10.0

TABLE 3

Showing the average daily soilage consumption of Philippine horses by the month

MONTH	KIND OF SOILAGE	LICUS	COUNCILOR	SULTAN	LUCK	PRINCE	CAPITANA	QUEEN
1928	1928							
January	Guinea grass	12.3	11.7	——	13.3	10.2	14.2	14.8
February	Guinea grass and cut corn fodder	12.4	11.0	——	12.1	10.4	11.4	13.4
March	Guinea grass and cut corn fodder	16.0	13.8	15.6	12.2	10.4	12.7	——
April	Cut Napier grass and cut corn fodder	16.2	13.6	17.2	14.9	13.3	12.6	——
May	Guinea grass	6.7	13.3	16.6	13.3	13.9	13.3	——
June	Guinea grass	10.4	10.0	10.6	10.6	11.4	13.0	——
July	Guinea grass and cut Napier grass	10.7	12.5	13.8	14.4	10.9	——	11.4
August	Cut corn fodder and cogon	14.9	13.9	13.4	14.7	14.5	——	19.5
September	Cut corn fodder, cogon and Guinea grass	14.5	18.9	18.1	18.4	19.9	——	20.6
October	Cut Napier grass, Guinea grass and cogon	11.5	14.6	15.2	14.2	13.3	——	19.3
November	Cut corn fodder and Guinea grass	14.6	16.2	18.6	18.8	19.5	——	21.3
1927								
December	Cut Napier grass and cut corn fodder	13.7	12.6	——	13.3	13.7	13.6	13.4
	Average	12.8	13.5	15.5	14.2	13.5	13.0	16.7

DISCUSSION OF RESULTS

Soilage consumption

Table 2 shows the 10-day average of Guinea grass consumed by three horses daily. With Service the average ranges from 13.1 to 17.6 kgm.; with Monday, from 15.2 to 17.8 kgm.; and with White, from 10.6 to 14.5 kgm. The general averages are 15.5 kgm. for Service, 16.3 kgm. for Monday, and 10.0 kgm. for White.

In table 3 the monthly averages of soilage consumed by various horses daily are given. Guinea grass predominates among the grasses used during the experiment. Corn fodder was used to a slightly greater extent than Napier grass, while cogon formed part of the feeds given in August and September only. The minimum monthly average of soilage consumed by the animals is 10.0 kgm. a day. This record was made by Councilor. The maximum monthly average consumption was 21.3 kgm. a day, which was made by Queen. The yearly average shows that Licus consumed the smallest amount or 12.8 kgm. a day and Queen the maximum amount or 16.7 kgm. a day. The following horses consumed intermediate amounts; Capitana, 13.0 kgm. daily; Prince and Councilor, 13.5 kgm. each; Luck, 14.2 kgm.; and Sultan, 15.5 kgm.

The general average soilage consumption for all the ten horses was 14.1 kgm. daily (see table 5).

TABLE 4

Showing the average daily water consumption of Philippine horses by the month

MONTH	LICUS	COUNCILOR	SULTAN	LUCK	PRINCE	QUEEN	CAPITANA
1928	*kgm.*	*kgm.*	*kgm.*	*kgm.*	*kgm.*	*kgm.*	*kgm.*
January	10.6	11.1	——	8.5	7.1	8.9	6.7
February	8.6	9.4	——	6.5	3.5	9.7	5.6
March	6.9	10.0	8.4	6.5	4.8	——	5.1
April	11.3	10.4	11.5	9.3	6.3	——	9.0
May	10.3	10.0	10.5	7.5	5.2	——	5.5
June	10.4	9.2	9.8	6.8	6.3	——	5.2
July	12.2	9.7	12.3	6.7	5.4	4.8	——
August	13.7	11.8	——	8.9	5.7	9.8	——
September	10.2	7.1	5.2	6.3	3.3	2.1	——
October	12.2	7.8	13.2	8.5	6.2	6.6	——
November	8.0	8.4	10.2	5.6	4.4	2.5	——
1927							
December	9.0	12.9	——	8.3	3.6	9.7	5.8
Yearly average	10.3	9.8	10.1	7.5	5.2	6.8	6.1

Water consumption

Table 4 shows the monthly average amount of water consumed by seven horses daily during one year. It is apparent that there is a great variation in the amount of water each animal consumed. As will be seen

later, the size of the animal does not necessarily indicate its ability to consume water. Contrary to expectation, the monthly average consumption is not markedly influenced by climatic conditions obtaining during certain seasons of the year. This is true with practically all horses in the experiment. It is possible that were these horses exposed in the pasture the thirst for water would have been greater when the temperature was high and weather conditions dry. Even with stabled horses, however, the avidity for water is some less when the weather is rainy and cool.

The variations in the water consumption of horses show that Queen drank the lowest average amount, 2.1 kgm. a day in September and Licus the largest average amount, 13.7 kgm. a day in August. The general average for the year with all horses, ranges from 5.2 kgm. daily, with Prince, to 10.3 kgm. daily, with Licus, The other horses drank amounts between these extremes. Capitana consumed an average of 6.1 kgm. a day; Queen, 6.8 kgm.; Luck, 7.5 kgm.; Councilor, 9.8 kgm.; and Sultan, 10.1 kgm.

The yearly average water consumption of all horses is 8.0 kgm. a day. (see table 5).

TABLE 5

Showing the ratio between the water and soilage consumption and weight of Philippine horses

HORSES	AVERAGE WEIGHT OF HORSES	AVERAGE SOILAGE CONSUMPTION	YEARLY AVERAGE WATER CONSUMPTION	RATIO BETWEEN SOILAGE CONSUMPTION AND WEIGHT OF HORSES	RATIO BETWEEN WATER CONSUMPTION AND WEIGHT OF HORSES
	kgm.	*kgm.*	*kgm.*	1 to	1 to
Service	244.0	15.5	——	15.7	——
Monday	252.2	16.3	——	15.5	——
White	176.4	10.0	——	17.6	——
Licus	253.1	12.8	10.5	19.8	24.6
Councilor	229.7	13.5	9.8	17.0	23.4
Sultan	234.6	15.5	10.1	15.1	23.2
Luck	217.4	14.2	7.5	15.3	29.0
Prince	221.8	13.5	5.2	16.4	42.7
Capitana	251.6	13.0	6.1	19.4	41.3
Queen	230.9	16.7	6.6	13.8	35.0
Average		14.1	8.0	16.6	31.3

Ratio between soilage consumption and weight of horses

The relation with ten horses between the amount of soilage a horse can consume and its weight is shown in table 5. The range is from a ratio of 1:13.8 with Queen to 1: 19.8 with Licus, the average ratio being 1: 16.6. That is, for every 16.6 kgm. of the live weight of a horse he may be given one kgm. of green roughage. A narrow ratio indicates greater feeding ability of the animal and vice versa. As a rule, there is general uniformity

in the proportion of roughages which horses of different weights may consume.

Ratio between water consumption and weight of horses

Unlike the ratio between soilage consumption and weight of horses, the relation between water consumption and the size of the animal shows much greater variation, as may be seen in table 5. The ratio ranges from 1:23.2 with Sultan to 1:42.7 with Prince. The average for the seven horses used in the experiment is 1:31.3. This ratio shows that for every 31.3 kgm. of the live weight of the horse he may be given one kgm. of water to satisfy his need, or approximately 3 per cent of the weight of the animal. Heavy water drinkers show a narrow ratio, and vice versa.

SUMMARY OF CONCLUSIONS

From trials conducted with Philippine horses on water and soilage consumption the following conclusions are presented:

1. The average daily consumption of soilage is from 12.8 kgm. to 16.7 kgm., the average for all horses being 14.1 kgm.

2. The average amount of water drank by the horses daily is from 5.2 kgm. to 10.5 kgm., the average for all horses being 8.0 kgm.

3. The ratio between the amount of soilage consumed and the weight of horses is from 1: 13.8 to 1:19.8. The average ratio for all horses is 1: 16.6.

4. The ratio between water consumption and the weight of horses is from 1: 23.2 to 1: 42.7. The average ratio for all horses is 1: 31.3.

EFFECT ON YOUNG RICE PLANTS OF ADDING ALUMINUM SALTS TO COMPLETE CULTURE SOLUTIONS[1]

FELIX VILLA

WITH SIX TEXT FIGURES

INTRODUCTION

Aluminum salts are reported as always present in the soil. They are absorbed by plants, and probably produce the toxic and stimulating effects similar to those obtained from pot and culture solution studies. But conditions not within the control of the investigators influenced most of the studies conducted in pot cultures. Of the solution studies made, the greater number were carried out by using cultures solutions that were not known to be suitable to the plants, and in some experiments the aluminum salts were added to only distilled water. Therefore, as might be expected, the results could not help but be harmful to the plants.

In the present study the aluminum salts, singly or separately, and in different amounts, were added to complete culture solutions. Some of these solutions are good, while the others are harmful to the young rice plants. In other words, the nutritive values for rice plants of the culture media here employed are definitely known. Hence, the results to be obtained from the present study may be considered as influenced by the aluminum salts employed.

Review of literature

Mirasol (1920) proved conclusively that aluminum is a determining factor in soil acidity. Based on results of their experiments on rye, barley, and pop corn, Conner and Sears (1922) report that the toxicity of aluminum salts was due to the aluminum ion more than it was to the hydrogen ion, and contend that acid soils are toxic to many plants largely because they contain soluble aluminum salts. Abbott, Conner, and Smalley (1913) found that aluminum nitrate was toxic to corn seedlings in dilute nutrient solutions and suggested that the acid radical might be the toxic agent. Miyake (1916) found that aluminum chloride was toxic to the rice plants grown in distilled water even in dilute solutions. The toxic effect was noticed when the salt was in a concentration greater than 0.000133 per cent. Hartwell and Pember (1918) found that aluminum sulfate was toxic to rye grown in a well balanced culture solution and suggested that the toxicity

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of this salt on barley was largely due to the aluminum. Stoklasa (1911) showed that a combined application of 9 kgm. (19.8 lbs.) of manganese and 4.48 kgm. (9.8 lbs.) of aluminum sulfate per hectare increased the yield of sugar beets from 30 to 50 per cent. He is of the opinion that aluminum is a catalytic agent, performing a function in the assimilation of carbon by promoting a more rapid process.

In investigating the effect of different salts of aluminum on the growth of *Zea mays*, *Vicia faba*, *Leus esculenta*, and *Helianthus annuus*, Kratzmann (1914) found that the growth was hindered by the salts when the concentration was 0.005 per cent, but stimulated when concentration was only

Fig. 1.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum nitrate. Culture E, without aluminum.

0.0001 per cent. Aluminum nitrate showed a toxic effect. Yamano (1905) found that moderate amounts of aluminum salts had a stimulating effect upon the development of barley and flax but he reports that in water culture, 0.2 per cent of alum (ammonium alum, A $(SO_4)_2(NH_4)+12$ aq.) proved injurious after three weeks, while 0.8 per cent killed the plant.

Object of the present study

The present study was to determine the effect upon young rice plants of soluble aluminum salts added separately in different amounts to complete culture solutions, the relative nutritive values of which for the rice plant are known.

Time and place

This investigation was conducted in the Laboratory of Plant Physiology of the College of Agriculture, University of the Philippines, Los Baños. The experiments were begun in July, 1927 and were closed in February, 1928.

MATERIALS AND METHODS

The plant

Young plants of Hambas variety, a lowland rice, were used in this study. Seeds obtained from the Agronomy Department were soaked in water for twenty-four hours. They were then spread between sheets of blotting paper and kept there until they had started to germinate. The germinating seeds were spread on paraffined bobbinet tied over the mouth of a large museum jar containing tap water. The germinator was kept full of water and was kept in the glass chamber of the laboratory. When the seedlings were about six centimeters high, vigorous and uniformly developed seedlings were selected and planted in prepared culture bottles containing the culture solutions. Each culture bottle, which had a capacity of 60 cubic centimeters, was provided with a two-holed cork in which

Fig. 2.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum sulfate. Culture E, without aluminum.

the seedlings were mounted. The culture bottles were wrapped with carbon and Manila paper, to keep the roots of the plants in darkness. Loose cotton plugs, inserted in the holes of each cork, held the seedlings in good position. The cultures were kept in the glass chamber of the Plant Physiology laboratory.

The culture solutions

The aluminum salts. Aluminum nitrate and aluminum sulfate were used in this study. They were separately dissolved in distilled water in one molar concentration. Subsequent dilutions were made and each salt was finally added to the culture solutions in concentrations of 0.00025, 0.00050, and 0.00075 gram-molecule. This was later changed and during the latter part of the study the concentrations of the aluminum salts were in parts per million. One gram of each salt was dissolved in distilled water, to make a solution of one liter. One cubic centimeter of this solution when

diluted to 1000 cubic centimeters of the culture solution produced a mixture in which the concentration of the aluminum salt was one part per million. Each of the aluminum salts was added to the culture solution at concentrations of 3, 5, and 8 parts per million.

The four-salt solutions. The standard four-salt culture solutions were prepared as described by Espino in 1920. Only Baker's analyzed salts were used. Excluding the salt of aluminum, each culture solution had a total concentration of 0.002 gram-molecule (of all the salts taken together) per liter. The cultures designated A_1, A_2 and A_3 each had the four main salts (in gram-molecule) KH_2PO_4, 0.00025; $Ca(NO_3)_2$, 0.000375; $(NH_4)_2SO_4$, 0.000375; and $MgSO_4$, 0.001. Cultures B_1, B_2 and B_3, each had KH_2PO_4, 0.00025; $Ca(NO_3)_2$, 0.00025; $(NH_4)_2SO_4$, 0.00025; and $MgSO_4$,

Fig. 3.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum nitrate. Cultures Ao, Bo, Co, and Do, without aluminum.

0.000125. Cultures C_1, C_2 and C_3 each had KH_2PO_4, 0.00025; $Ca(NO_3)_2$, 0.00125; $(NH_4)_2SO_4$, 0.00025; and $MgSO_4$, 0.00025. Cultures D_1, D_2 and D_3 each had KH_2PO_4, 0.00125; $Ca(NO_3)_2$, 0.00025; $(NH_4)_2SO_4$, 0.00025; and $MgSO_4$, 0.00025 gram-molecule. To supply the plants with iron, a few drops of the solution of ferric phosphate were added to each culture medium. To serve as controls, cultures Ao, Bo, Co, and Do were supplied with only the four main salts and a trace of iron as ferric phosphate; no salt of aluminum was added.

Culture solutions were renewed at the end of every two days, and this procedure was followed for a period of thirty days, or up to the time of harvest.

EXPERIMENTS AND RESULTS

Plan of the experiments

The different sets of cultures were conducted as follows:

Set I. This set was carried from August 9 to September 9, 1927. It consisted of 12 different cultures supplied with aluminum nitrate, each culture was in duplicate; and for control one culture grown in Espino's best four-salt culture solution without aluminum. A similar set of cultures was conducted at the same time, with the aluminum supplied as aluminum sulfate. The aluminum salts were added to the culture solutions in different amounts, (none for the control and 0.00025, 0.0005, and 0.00075 gram-molecule for the test cultures). The results are shown in table 1.

Set II. The plan of the experiment in set I was improved by including a control culture for each culture type. For example, culture Ao served as the control only for cultures A_1, A_2, and A_3. Culture types designated as B, C, and D each had a control culture in which the proportions of the main

Fig. 4.—Young rice plants growing in complete culture solutions containing 0.00025, 0.0005 and 0.00075 gram-molecule of aluminum sulfate. Cultures Ao, Bo, Co, and Do, without aluminum.

salts were the same as those in test cultures. In set II, which was run from August 25 to September 25, 1927, the two aluminum salts, in amounts that were used in set I were added separately in gram-molecule and each culture was run in duplicate. The data obtained are in table 2.

This set of cultures was tried again from November 6 to December, 6, 1927 and the results are shown in table 3.

Set III. The presence of either aluminum salt, $Al(NO_3)_3$ or $Al_2(SO_4)_3$, in previous cultures proved harmful, that is, the plants from the control cultures were better than those from the corresponding test cultures. It was, therefore, decided to reduce the concentration or amount of the aluminum salts in the culture solutions. To effect this reduction

in concentration, the aluminum salts were added to the culture solution in term of parts per million. No aluminum salt was added to the control cultures, but the test cultures received an aluminum salt at the rate of 3, 5 and 8 parts per million. The experimental data are given in table 4. Following this scheme, a set of cultures (see table 4) was started January 20 and run to February 20, 1928. Owing to lack of time this set was not tried again.

Experimental results

External appearance of the plants. The general external appearance of the plants at the end of each experimental period was noted. A photograph of the plants grown in each set in one of the trials was taken at the end of the culture period (see fig. 1–6). The last vertical columns in tables 1–4 inclusive, show the data on the external appearance of the plants that were gathered at the time of harvest.

Fig. 5.—Young rice plants growing in complete culture solutions containing 3, 5 and 8 parts per million of aluminum nitrate. Cultures Ao, Bo, Co, and Do, without aluminum.

Height of tops and length of roots. At the end of each culture period, the highest top and longest roots of the two plants in each culture were measured. The average height of tops of each duplicate culture was taken expressed in "relative value" with reference to the control. The relative values of the heights of tops may be found in the third and fourth vertical columns in tables 1–4, inclusive.

The average length of roots of each duplicate culture was also taken. The fifth and sixth vertical columns in tables 1–4, inclusive, show the data on "relative values" of length of roots with reference to control.

Dry weight of plants. After measuring the height of tops and length of roots, the seeds were detached from the plants. The two plants from each culture were combined and wrapped with paper. They were then

dried to constant weight in an electric oven at about 100° C. The dry weights of the tops and of the roots were separately determined with the use of an analytical balance. The average weight of the plants (tops and roots) was taken and the data thus obtained are shown in the seventh and eighth vertical columns in tables 1 to 4, inclusive, expressed in "relative values" with reference to the control.

DISCUSSION OF RESULTS

General appearance of plants

All the plants grown in complete culture solutions to which aluminum salts in concentrations 0.00025, 0.00050, or 0.00075 gram-molecule were added were rather abnormally developed. In the four different culture types (A, B, C, and D) the test cultures, that is, those to which aluminum salts were separately added, produced plants which were decidedly inferior to those in the control cultures (see fig. 1–4, and description in tables 1–3).

Fig. 6.—Young rice plants growing in complete culture solutions containing 3, 5 and 8 parts per million of aluminum sulfate. Cultures Ao, Bo, Co, and Do, without aluminum.

However, the plants from control cultures (E in fig. 1 and 2 and Ao and Bo in fig. 3 and 4) in which the plants were supplied with four-salt culture solutions known to be suitable for the normal growth and development of the young rice plants were normally developed. Hence, the aërial environment was satisfactory for the life of the plant, and the relatively poor results obtained from the test cultures in the same set must, therefore, be due to the influence of the aluminum salts that were added to the culture solutions. It should be said that the harmful effects of the aluminum salts upon the young rice plants were very marked. This condition was probably due to the fact that the aluminum salts were added to the culture solutions in comparatively large amounts.

In the latter part of this study, when the concentrations of the aluminum salts used were much lower (3, 5, and 8 parts per million) than the

amounts referred to above, the plants in the test cultures were quite well developed, very much better looking plants than those obtained from the test cultures in the first part of this study, where the concentrations of the aluminum salts were comparatively higher. The control cultures and test cultures produced plants (see table 4 and fig. 5 and 6) that were about equally developed.

Comparing effects upon the plant of nitrate and sulfate of aluminum

Examination of the data under columns I and II under each of the criteria in table 1, which were gathered simultaneously, will show that the aluminum nitrate in complete culture solutions was about as harmful as the aluminum sulfate, when supplied to the young rice plants under similar conditions. Similar relative results were obtained when the experiments, with slight modifications, were repeated, (see tables 2, 3 and 4). These findings confirm the toxic effects on rye of aluminum sulfate as were reported by Hartwell and Pember (1916) and the toxic effects on corn seedlings by aluminum nitrate, (Abbott, *et al* 1913).

Comparing effects upon rice plants of aluminum salts added to "good" and to "poor" culture solutions

For the purposes of this comparison, the data on the dry weight of tops and roots in tables 2 to 4 were compiled and are presented in table 5. The data in table 5 are expressed in percentages of the inferiority of the test cultures supplied with aluminum salts to the corresponding control cultures.

In table 5 it may be seen that, with few exceptions, and these exceptions are mostly from the cultures which were supplied with solutions of aluminum salts in extreme dilution, the aluminum salts were more harmful when added to a *poor* culture solution than when added to a *good* culture medium. The difference, however, was not noticed when the aluminum salts were employed in extreme dilution, 3, 5, and 8 parts per million.

Influence of concentration of aluminum salts

The presence in complete culture solution of aluminum sulfate in concentrations 3, 5, or 8 parts per million, although apparently harmful to the young rice plants under the criterion of dry weight of tops and roots, yet in term of height of tops, they produced stimulating effects. Most of the data on average height of tops in table 1 bear out this contention. The growth in length of the roots in several cultures was also apparently favorably influenced by the presence in the culture medium of a very small amount of either of the two aluminum salts. The decrease in dry weight of the plant accompanied by an increase in height of tops and in length of roots, ultimately resulted in a rather slender plant. Therefore, the decidedly marked effect upon the young rice plant of nitrate of aluminum when present in a very small amount in a complete culture, was to induce the plant to become slender.

Harmful effects of aluminum influenced by weather

The inferiority of the cultures supplied with either of the aluminum salts used when compared with the corresponding control cultures (without aluminum) was apparently partly due to weather. To help bring out this contrast clearly, table 6 is presented. In this table may be seen the weekly records of rainfall, temperature of the air, and the atmometric readings gathered during the time when the August 25 to September 25, and November 6 to December 6 cultures were being conducted. These weather records when correlated with certain data shown in table 5, likewise gathered during the same periods of time, will bring out the fact that as the weather conditions became less favorable for the young rice plant, the harmful effects of aluminum nitrate or of aluminum sulfate, became more intensified. The records of precipitation, of air temperature, and of evaporation and insulation obtained about the time when the August 25 to September 25 plantings were under observation, were a little higher than the corresponding weather records obtained about the time when the November 6 to December 6 plantings were made. It appears then that the weather conditions in the August 25 to September 25 plantings were more favorable for the development of the young rice plants than those in the November 6 to December 6 plantings. This contention is borne out by certain data in table 5, (from the third to the sixth columns). These columns of figures show that the inferiority of the test cultures to the corresponding control cultures (in term of dry weight of tops and root) obtained during the less favorable weather conditions was roughly 30 to 50 per cent. The temperature of air and intensity of sunlight (insulation) appear to be the influencing factors.

SUMMARY AND CONCLUSIONS

1. The toxicity of aluminum nitrate to young rice plants in complete culture solution was found to be about the same as that of the aluminum sulfate.

2. At concentration 0.00025, 0.0005 or 0.00075 gram-molecule, both aluminum nitrate and aluminum sulfate were more harmful when added to *poor* culture solutions than when added to *good* culture solutions.

3. Both salts of aluminum, ($Al(NO)_3$ and $Al_2(SO_4)_3$) in a concentration of 3, 5 or 8 parts per million, when aded to *poor* culture solutions and to *good* culture solutions produced about the same effects upon the young rice plants.

4. At a concentration of 3, 5 or 8 parts per million, both aluminum nitrate and aluminum sulfate, when separately added to complete culture solutions, stimulated the growth in height of the young rice plants, although apparently harmful under the criterion of dry weight of tops and roots.

5. As the weather conditions became less favorable, the harmful effects of aluminum nitrate or of aluminum sulfate upon the young rice plants increased. The inferiority of the test cultures to the corresponding control cultures (in term of dry weight of top and root) obtained during less favorable weather conditions was roughly 30 to 50 per cent.

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TABLE 1

Showing data in "relative values" obtained from trial 1 in which young rice plants were supplied with complete culture solution which aluminum nitrate or aluminum sulfate added in different amounts (Conducted August 9 to September 9, 1927)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT ADDED TO CULTURE SOLUTIONS	AVERAGE HEIGHT OF TOPS		AVERAGE LENGTH OF ROOTS		AVERAGE DRY WEIGHT OF TOPS AND ROOTS		EXTERNAL APPEARANCE OF PLANTS AT HARVEST
	gram-molecule	I[a]	II[b]	I[a]	II[b]	I[a]	II[b]	
A_1	0.00025	91	94	70	55	70	67	I and II plants unhealthy, leaves narrow and pale, old leaves dry, young leaves light yellow; roots not well developed, plenty, brownish
A_2	0.00050	91	83	59	63	65	62	I and II, same as above
A_3	0.00075	75	80	54	54	50	55	I and II, same as above
B_1	0.00025	90	87	69	51	68	62	I, same as above II, plants somewhat stunted, leaves narrow and pale with dry tips, old leaves dry, young leaves slightly yellow; roots normally developed, brownish
B_2	0.00050	96	105	74	52	75	97	I, same as above II, plants healthy and vigorous, leaves green but not broad; roots normally developed, plenty, brownish
B_3	0.00075	89	70	77	54	66	47	I, same as above II, plants somewhat stunted, leaves narrow and pale, tips dry, old leaves dry, young leaves slightly yellow, roots abnormally developed, brownish
C_1	0.00025	89	75	68	60	55	45	I, same as above II, plants stunted, leaves narrow and pale with dry tips; roots not well developed, brownish
C_2	0.00050	92	107	93	79	74	69	I and II, plants unhealthy, very slender, leaves very narrow and pale, old leaves dry, young leaves yellow; roots few, brownish
C_3	0.00075	91	67	65	65	54	44	I and II, same as above
D_1	0.00025	57	62	57	61	21	30	I and II, plants greatly stunted, old leaves dry, rest of leaves yellow and half dry; roots few and poorly developed, brownish
D_2	0.00050	58	61	68	61	21	30	I and II, same as above
D_3	0.00075	55	54	64	53	24	31	I and II, same as above
Control	none	100 (34.0 cm.)	100	100 (19.4 cm.)	100	100 (0.153 gram)	100	I and II, plants normally developed

[a] I—Cultures supplied with aluminum nitrate.

[b] II—Cultures supplied with aluminum sulfate.

TABLE 2

Showing data in "relative values" obtained from trial 2 in which young rice plants were supplied with complete culture solutions to which aluminum nitrate or aluminum sulfate was added in different amounts (Conducted August 25 to September 25, 1927)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT ADDED TO CULTURE SOLUTIONS	AVERAGE HEIGHT OF TOPS		AVERAGE LENGTH OF ROOTS		AVERAGE DRY WEIGHT OF TOPS AND ROOTS		EXTERNAL APPEARANCE OF PLANTS AT HARVEST
	gram-molecule	I[a]	II[b]	I[a]	II[b]	I[a]	II[b]	
A_0 (control)	none	100 (37.9 cm.)	100	100 (15.25 cm.)	100	100 (0.105 gram)	100	I and II, plants normally developed
A_1	0.00025	79	85	89	98	68	100	I and II, plants unhealthy, leaves narrow and pale with dry tips, youngest leaves yellow, roots few, brownish
A_2	0.00050	86	78	82	113	80	87	I and II, same as above
A_3	0.00075	82	76	82	95	71	84	I and II, same as above
B_0 (control)	none	100 (39.0 cm.)	100	100 (14.85 cm.)	100	100 (0.109 gram)	100	I and II, plants normally developed
B_1	0.00025	81	79	90	101	68	77	I and II, plants unhealthy, leaves narrow and pale with dry tips, youngest leaves slightly yellow, roots few, brownish
B_2	0.00050	81	80	88	100	69	88	I and II, same as above
B_3	0.00075	77	73	92	94	61	72	I and II, same as above
C_0 (control)	none	100 (33.45 cm.)	100	100 (16.75 cm.)	100	100 (0.096 gram)	100	I and II, plants not very vigorous, leaves narrow and slightly pale; roots few, brownish
C_1	0.00025	78	79	92	81	56	62	I and II, plants stunted, all leaves narrow and very pale with dry tips; roots very few, brownish
C_2	0.00050	103	84	93	86	79	76	I and II, same as above
C_3	0.00075	95	85	76	84	74	89	I and II, same as above
D_0 (control)	none	100 (32.0 cm.)	100	100 (15.20 cm.)	100	100 (0.085 gram)	100	I and II, plants somewhat stunted, leaves narrow and pale with dry tips; roots very few, brownish
D_1	0.00025	73	71	93	83	53	55	I and II, plants greatly stunted, all leaves yellow with long dry tips; roots very few, brownish
D_2	0.00050	72	66	92	83	43	59	I and II, same as above
D_3	0.00075	70	70	92	93	43	59	I and II, same as above

[a] I—Cultures supplied with aluminum nitrate.

[b] II—Cultures supplied with aluminum sulfate.

TABLE 3

Showing data in "relative values" obtained from trial 3 in which young rice plants were supplied with complete culture solutions to which aluminum nitrate or aluminum sulfate was added in different amounts (Conducted November 6 to December 6, 1927)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT ADDED TO CULTURE SOLUTIONS	AVERAGE HEIGHT OF TOPS		AVERAGE LENGTH OF ROOTS		AVERAGE DRY WEIGHT OF TOPS AND ROOTS		EXTERNAL APPEARANCE OF PLANTS AT HARVEST
	gram-molecule	I[a]	II[b]	I[a]	II[b]	I[a]	II[b]	
A_0 (control)	none	100 (38.0 cm.)	100	100 (13.35 cm.)	100	100 (0.154 gram)	100	I and II, plants normally developed
A_1	0.00025	86	93	79	79	37	61	I and II, plants not vigorous, leaves narrow and pale; roots well developed, brownish
A_2	0.00050	96	82	68	72	47	47	I and II, same as above
A_3	0.00075	83	80	65	58	49	50	I and II, same as above
B_0 (control)	none	100 (35.45 cm.)	100	100 (15.00 cm.)	100	100 (0.153 gram)	100	I and II, plants normally developed
B_1	0.00025	104	86	67	65	56	47	I and II, plants unhealthy, slender, leaves narrow and pale; roots not well developed, brownish
B_2	0.00050	103	96	59	60	56	59	I and II, same as above
B_3	0.00075	87	87	56	72	45	51	I and II, plants somewhat stunted, leaves narrow and pale; roots poorly developed, few, brownish
C_0 (control)	none	100 (34.30 cm.)	100	100 (15.35 cm.)	100	100 (0.136 gram)	100	I and II, plants not very vigorous, leaves a little narrow; roots not well developed, brownish
C_1	0.00025	84	94	76	66	45	50	I and II, plants stunted, leaves narrow, pale with dry tips; roots poorly developed, brownish
C_2	0.00050	96	92	59	52	50	55	I and II, same as above
C_3	0.00075	88	87	56	58	41	54	I and II, same as above
D_0 (control)	none	100 (33.2 cm.)	100	100 (11.35 cm.)	100	100 (0.121 gram)	100	I and II, plants not vigorous, leaves narrow, slightly pale; roots plenty, brownish
D_1	0.00025	56	84	86	79	26	36	I and II, plants greatly stunted, all leaves yellow, drying; roots very poorly developed
D_2	0.00050	60	79	84	82	27	43	I and II, same as above
D_3	0.00075	64	70	79	90	30	36	I and II, same as above

[a] I—Cultures supplied with aluminum nitrate.

[b] II—Cultures supplied with aluminum sulfate.

TABLE 4

Showing data in "relative values" obtained from trial 4 in which young rice plants were supplied with complete culture solutions to which aluminum nitrate or aluminum sulfate was added in different amounts (Conducted January 20 to February 20, 1928)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT ADDED TO CULTURE SOLUTIONS	AVERAGE HEIGHT OF TOPS		AVERAGE LENGTH OF ROOTS		AVERAGE DRY WEIGHT OF TOPS AND ROOTS		EXTERNAL APPEARANCE OF PLANTS AT HARVEST
	p. p. m.	I[a]	II[b]	I[a]	II[b]	I[a]	II[b]	
A_0 (control)	none	100 (37.65 cm.)	100	100 (19.0 cm.)	100	100 (0.145 gram)	100	I and II, plants normally developed
A_1	3	112	102	103	81	72	85	I, plants healthy, vigorous, leaves brownish and green; roots well developed, brownish II, plants healthy, vigorous, leaves broand and green; first and second leaves with dry tips; roots well developed
A_2	5	98	102	107	99	83	80	I, same as I above II, same as II above
A_3	8	105	99	105	93	82	75	I, same as I above II, same as II above
B_0 (control)	none	100 (35.5 cm.)	100	100 (18.5 cm.)	100	100 (0.130 gram)	100	I and II, plants normally developed
B_1	3	117	108	89	103	73	90	I and II, plants healthy, vigorous; green broad leaves; roots well developed, brownish
B_2	5	117	113	92	109	70	90	I and II, same as above
B_3	8	107	109	90	100	60	92	I and II, same as above
C_0 (control)	none	100 (34.75 cm.)	100	100 (14.5 cm.)	100	100 (0.124 gram)	100	I and II, plants not very vigorous, leaves narrow, lightly pale; roots well developed, brownish
C_1	3	111	105	119	126	79	71	I and II, plants not vigorous, leaves narrow and slightly pale, two old leaves with dry tips; roots not well developed, brownish
C_2	5	115	111	139	127	80	84	I and II, same as above
C_3	8	115	99	128	112	88	83	I and II, same as above
D_0 (control)	none	100 (32.75 cm.)	100	100 (21.75 cm.)	100	100 (0.109 gram)	100	I and II, plants not vigorous, leaves narrow and pale, oldest leaves dry, second leaves with dry tips; roots well developed, brownish
D_1	3	117	112	88	92	87	86	I and II, plants unhealthy, stunted, leaves narrow and pale, mostly with dry tips; roots not well developed, brownish
D_2	5	105	111	71	94	83	87	I and II, same as above
D_3	8	108	108	83	80	74	89	I and II, same as above

[a] I—Cultures supplied with aluminum nitrate.

[b] II—Cultures supplied with aluminum sulfate.

TABLE 5

Showing data (in percentages), on the inferiority of the cultures with aluminum salts to the corresponding control cultures without aluminum (Compiled from tables 2 to 4 inclusive)

CULTURE DESIGNATION	CONCENTRATION OF ALUMINUM SALT	$Al(NO_3)_3$		$Al_2(SO_4)_3$		CONCENTRATION OF ALUMINUM SALTS	$Al(NO_3)_3$	$Al_2(SO_4)_3$
		a a	a b	a a	a b			
	gram-molecule	Aug 25 Spet. 25	Nov. 6 Dec. 6.	Aug. 25 Sept. 25	Nov. 6 Dec. 6	*parts per million*	Jan. 20	Feb. 20
A_1	0.00025	32	63	0	39	3	28	15
A_2	0.00050	20	53	13	53	5	17	20
A_3	0.00075	29	61	16	50	8	18	25
B_1	0.00025	32	44	23	53	3	27	10
B_2	0.00050	31	44	12	41	5	30	10
B_3	0.00075	39	56	28	49	8	40	8
C_1	0.00025	44	55	38	50	3	21	29
C_2	0.00050	21	50	24	45	5	20	16
C_3	0.00075	26	59	11	46	8	12	17
D_1	0.00025	47	74	45	64	3	13	14
D_2	0.00050	57	73	41	57	5	17	13
D_3	0.00075	57	70	41	64	8	26	11

[a] *a* and *b* under salts of aluminum, are results from two trials of a set of culture.

TABLE 6

Weekly weather records obtained from the records of the Weather Observer for the College of Agriculture

WEEK ENDING	RAINFALL	TEMPERATURE OF AIR			ATMOMETER READINGS	
		Max.	Min.	Mean	Evaporation	Insulation
1927	*mm.*	*°C*	*°C*	*°C*	*cc.*	*cc.*
Aug. 27	61.8	30.4	24.9	32.8	214	93
Sept. 3	15.2	31.0	24.6	27.8	218	113
Sept. 10	31.1	32.2	24.1	28.2	206	117
Sept. 17	28.5	31.2	24.1	27.7	122	104
Sept. 24	147.9	31.4	24.4	27.9	147	98
	284.5	32.1	24.4	28.9	907	525
Nov. 11	18.3	29.5	24.2	26.8	102	62
Nov. 18	53.0	29.1	24.6	26.8	89	68
Nov. 25	116.2	29.2	24.4	26.8	109	80
Dec. 2	0	29.6	23.4	26.5	169	103
Dec. 9	48.1	29.4	24.4	26.9	85	55
	235.6	29.4	24.2	26.7	554	368

A COMPARATIVE STUDY OF THE GROWTH AND DEVELOPMENT OF KIDS OF MILKING AND NON-MILKING DOES[1]

LEONCIO M. LIMPIADO

WITH TWO CHARTS

The prospects for establishing goat dairies in the Philippines are bright. One of the problems generally attending a dairy establishment, however, is the raising of young animals. Hence, a study of comparing the growth and development of kids of does that are milked regularly with kids following mothers that are not milked at all should be of value. In this paper, the does that were milked will be designated as "milking does"; those that were not milked as "non-milking" does.

The objects of this investigation were to determine the comparative increase in weight and measurements in height at withers, length of back, length of rump, width of rump, heart girth, and circumference of barrel of kids of milking and non-milking does.

This work was conducted in the Department of Animal Husbandry, College of Agriculture, University of the Philippines, from January 18, 1925 to March 31, 1926, covering a period of one year, two months, and thirteen days.

MATERIALS

Animals

There were in all 34 kids used in this investigation, of which 22 were of the milking does and 12 of the non-milking mothers. All possessed Indian blood in varying proportions.

Ten of the kids of the milking does were females and the rest, or 12, were males. Five of the kids of the non-milking does were females and seven were males.

Feeds

The concentrates given to the milking does consisted of eight parts, by weight, of corn, five parts of copra meal, and one part of rice bran. For roughage, the animals had access to a variety of grasses and other succulence in the pasture where they were turned out during the day. At night they were supplied with either Guinea grass, Napier grass or corn fodder, depending on which one of these grasses was available.

[1] Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 283; Experiment Station contribution No. 594. Prepared in the Department of Animal Husbandry under the direction of Dr. Valente Villegas.

Pen and feed racks

The animals were provided with three pens where they were kept at night. One of these pens was used for the milking does, one for their kids, and one for the non-milking mothers and kids. All pens were fenced with woven wire 38 inches high nailed on ipil ipil posts. For the pen for milking does, poultry wire netting was placed over the woven wire fence so that the kids could not get into the pen during the night and nurse from their mothers. Sheets of galvanized iron were placed on the fence during stormy or rainy weather to protect the animals from rain and cold wind. In both pens the flooring was of dirt.

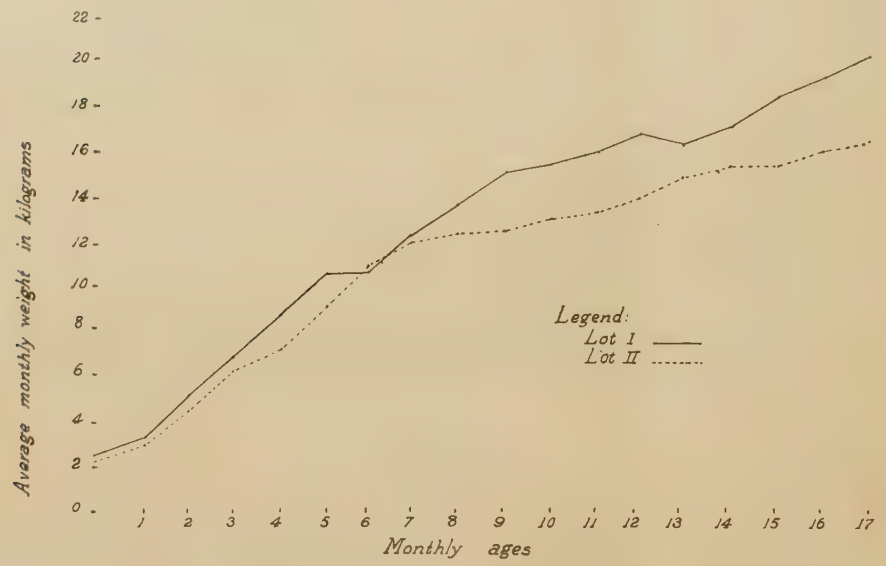

Fig. 1.—Showing weight-age curves of kids in lots I and II.

The feed racks were of two types and were made of wood. One type was for roughage and the other for concentrates. Both were so constructed as to prevent the animals from goring one another. Sections of bamboo with one side cut off were hung on the fences for salt troughs; common salt was placed in these once a week.

Milking stand

A stand was used in milking the does of lot I. It was made of wood and the platform was 68.5 centimeters high and large enough for the doe to stand on. A stanchion was provided on one end, and on both sides were wooden bars to keep the does from moving from one side to another. In front of the stanchion was a box in which concentrates were put for the does to feed on while they were being milked.

Measuring instruments

A wooden caliper, a meter stick, and a steel tape, all graduated into metric denominations were used in measuring the animals. They were weighed on a Fairbanks portable scale. A box of suitable height on which the kids were made to stand was found very convenient in making the measurements.

MANAGEMENT

The does and kids were separated into two groups. One group consisted of milking does with their kids, and the other group, of the non-milking mothers and their kids.

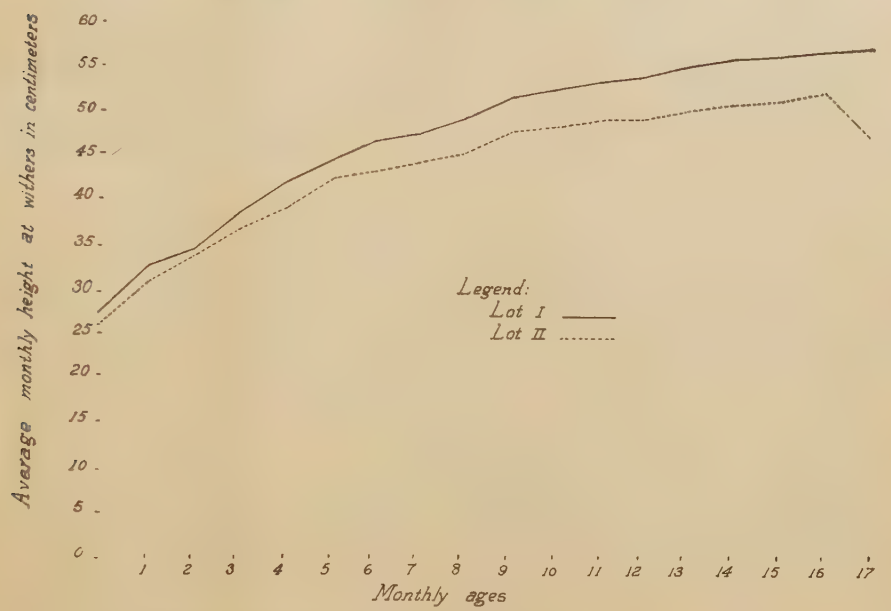

Fig. 2.—Showing height-at-withers-age curves of kids in lots I and II.

The milking does were those that were milked every day for dairy purposes. They were pastured in the daytime and at night they were kept in pens where they were given concentrates and roughage. The kids went with their mothers in the pasture in the daytime but they were separated at night. The kids and the mothers were given the same kinds of grain and forage at night.

From the sixth day after kidding till the end of lactation the milking does were milked dry in the morning.

The kids of non-milking does were with their mothers at all times. They were pastured in the morning and housed with the main herd in a goat pen at night. In contrast with the milking does, no feed was given to the non-milking mothers nor their kids in the pen at night, but, obviously,

the kids had access to the milk of their mothers at all times. The kids ran with their dams until they were weaned naturally.

Weighing and measuring the kids

During the whole period of the work, the weighing and measuring of all the animals of both groups were carried out weekly in the morning. The animals were placed squarely on their legs before any measurement was taken.

Measurements were taken on the left side of the animals only. The following points were determined and included in this report:

Weight. The weight records, in kilograms, were made directly from the readings of the scale.

Height at withers. The perpendicular distance from the ground to the top of the withers.

Length of back. The distance between the withers and the loin, (marked by a line connecting the hip bones).

Length of rump. The distance between the loin and the base of the tail.

Width of rump. The distance between the hips across the loin.

Heart girth. This measurement was taken around the chest of the animal just behind the shoulder.

Circumference of barrel. The measurement around the largest part of the barrel of the animal.

DISCUSSION OF RESULTS

For the sake of brevity, the kids of milking does will be designated as of lot I and those of the non-milking group as of lot II.

Weight

Table 1 shows that kids of lot I increased in weight steadily up to the age of 17 months, excepting in the thirteenth month when an average decrease of 0.13 kilogram was recorded. The largest increase took place in the fifth month when an average increase of 2.13 kilograms was made. In general, greater increases were made during the early age of the animals. Similar behavior in the rate of increases in weight was observed with animals of lot II. As in lot I, the greatest increase, an average of 2.00 kilograms, was in the fifth month. The rate of increase in lot I was generally higher than in lot II.

As is shown in figure 1, animals of lot I were, in general, heavier than those of lot II. It was only at the age of six months that animals of lot I were outweighed by those of lot II. At the beginning animals of lot I had an advantage over those of lot II, but the difference was small.

Height at withers

It may be seen in table 2, that in both lots I and II, the greatest increases in height of the kids were observed during the first month of age. Lot I had an average of 4.66 cm., and lot II, 4.16 cm. The increases became less as the animals advanced in age. Greater increases were recorded with animals of lot I than with those of lot II.

In figure 2, it may be seen that from the beginning to the age of 17 months, kids of lot I were taller than those of lot II.

Length of back

Table 3 shows that kids of lot I registered the greatest increase in length of back, an average of 3.04 cm. at the age of four months; while animals of lot II made the largest increase, an average of 2.59 cm., at the age of one month. In both lots the rate of increase became less as the animals grew older, but kids of lot I generally made greater increase in length of back than those of lot II.

Length of rump

Table 4 shows that in general the two lots of kids registered less and less increase in length of rump from the age of one month up to the seventeenth month. The maximum increase, an average of 1.26 cm., in lot I was at the age of one month; in lot II the maximum increase, an average of 1.89 cm., was at the age of four months.

Width of rump

According to table 5, kids of lots I and II made the greater increases in the first months. The maximum increase, an average of 1.39 cm., in the case of lot I was made at the age of four months. In the case of lot II the greatest increase, an average of 1.43 cm., was made at the age of one month. In general greater gains were made by animals of lot I than by those of lot II.

Heart girth

It is evident from data in table 6 that the increase in heart girth of animals of lots I and II was greater in the early age of the animals. In lot I, the highest recorded increase, an average of 4.57 cm., was at the age of two months; while with lot II the highest increase, an average of 4.45 cm., was at the age of three months. As a rule, greater increases were made by animals of lot I than by those of lot II.

Circumference of barrel

The increase in the circumference of barrel of both groups of animals, according to table 7, was greater during the early life of the kids. Animals of both lots made their maximum increase at the age of two months, an

average of 8.75 cm. for lot I, and 8.03 cm. for lot II. Greater increases were made generally by the animals of lot I than by those of lot II.

It is clear that the increase in weight and measurements of the different parts of the body of the kids in lot I was greater from the beginning up to the age of seventeen months than that of animals in lot II, the difference becoming greater as the animals grew older. The circumference of barrel of kids of lot II exhibited greater growth than those of lot I from the age of thirteen months up to the seventeenth month. At the age of seventeen months, both groups showed the same measurement. The general advantage of kids of lot I, or kids of the milking does, over those of lot II, or kids of the non-milking mothers, may be due partly to the slightly greater weight and size of the lot I kids at birth. As they grew older, and were separated from their mothers at night, the greater difference in growth and measurements of animals of lot I may be due mainly to the extra feeding they got at night in the form of concentrate and grass. It may be recalled that kids of lot II, those of non-milking mothers, as well as the dams themselves, did not have access to any feed at all during the night except the milk the kids received from their mothers.

SUMMARY AND CONCLUSION

In general, it may be said that kids following does used for dairy purposes may be raised at even greater advantage than those going with non-milking does. Therefore, it is safe to state that under normal conditions goat dairies can be made to produce milk as well as live animals for slaughter and for replacing old dairy stock.

TABLE 1

Showing the average monthly weight and increase in weight of kids in lots I and II

AGE	LOT I			LOT II		
	Number weighed	Average weight	Average increase	Number weighed	Average weight	Average increase
months		*kgm.*	*kgm.*		*kgm.*	*kgm.*
At birth	15	2.36	——	6	2.18	——
1	15	3.21	0.85	6	3.03	0.85
2	21	4.49	1.28	9	4.33	1.30
3	21	6.43	1.94	11	6.00	1.67
4	19	8.60	2.17	11	7.24	1.24
5	18	10.73	2.13	9	9.24	2.00
6	15	10.78	0.05	9	11.02	1.78
7	13	12.34	1.56	9	12.01	0.99
8	13	13.76	1.42	9	12.30	0.29
9	11	15.19	1.43	8	12.50	0.20
10	11	15.58	0.39	8	13.43	0.93
11	10	16.00	0.42	8	13.61	0.18
12	8	16.96	0.96	8	14.22	0.61
13	8	16.83	–0.13	7	15.40	1.18
14	8	17.62	0.79	7	15.84	0.44
15	7	18.41	0.79	7	15.92	0.08
16	7	19.60	1.19	6	16.73	0.81
17	7	20.37	0.77	5	17.14	0.41

TABLE 2

Showing the average monthly measurement and increase in height at withers of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average height	Average increase	Number measured	Average height	Average increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	27.30	——	6	26.25	——
1	15	31.96	4.66	6	30.41	4.16
2	21	34.83	2.87	9	33.96	3.55
3	21	38.47	3.64	11	36.55	2.59
4	19	41.60	3.13	11	39.19	2.64
5	18	44.41	2.81	9	42.06	2.87
6	15	46.19	1.78	9	43.03	0.97
7	13	46.60	0.41	9	44.80	1.77
8	13	49.33	2.73	9	45.33	0.53
9	11	51.77	2.44	8	48.12	2.79
10	11	52.77	1.00	8	48.81	0.69
11	10	54.30	1.53	8	49.43	0.62
12	8	54.96	0.66	8	49.56	0.13
13	8	55.58	0.62	7	50.07	0.51
14	8	56.12	0.54	7	50.64	0.57
15	7	56.24	0.12	7	51.00	0.36
16	7	56.92	0.68	6	51.41	0.41
17	7	57.28	0.36	5	48.50	–2.91

TABLE 3

Showing the average monthly measurement and increase in length of back of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	18.86	——	6	18.16	——
1	15	21.76	2.90	6	20.75	2.59
2	21	23.66	1.90	9	23.16	2.41
3	21	26.09	2.43	11	24.75	1.59
4	19	29.13	3.04	11	27.09	2.34
5	18	31.32	2.19	9	29.33	2.24
6	15	32.86	1.54	9	29.41	0.08
7	13	32.84	–0.02	9	31.72	2.31
8	13	34.03	1.19	9	32.33	0.61
9	11	35.59	1.56	8	33.81	1.48
10	11	36.27	0.68	8	34.44	0.63
11	10	37.00	0.73	8	35.12	0.68
12	8	37.87	0.87	8	35.81	0.69
13	8	38.31	0.44	7	35.78	–0.03
14	8	39.00	0.69	7	36.28	0.50
15	7	39.28	0.28	7	36.64	0.36
16	7	39.28	0.00	6	36.50	–0.14
17	7	39.67	0.39	5	36.40	–0.10

TABLE 4

Showing the average monthly measurement and increase in length of rump of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Averag increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	7.30	——	6	6.58	——
1	15	8.56	1.26	6	8.21	1.63
2	21	9.54	0.98	9	8.44	0.23
3	21	10.54	1.00	11	8.88	0.44
4	19	11.71	1.17	11	10.77	1.89
5	18	12.95	1.24	9	12.10	1.33
6	15	13.86	0.91	9	13.25	1.15
7	13	14.42	0.56	9	14.11	0.86
8	13	14.88	0.46	9	14.83	0.72
9	11	15.59	0.71	8	15.62	0.79
10	11	15.81	0.22	8	16.06	0.44
11	10	15.95	0.14	8	16.06	0.00
12	8	16.12	0.17	8	16.12	0.06
13	8	16.56	0.44	7	15.92	–0.20
14	8	16.87	0.31	7	16.07	0.15
15	7	17.07	0.20	7	16.07	0.00
16	7	17.14	0.07	6	16.08	0.01
17	7	17.17	0.03	5	16.10	0.02

TABLE 5

Showing the average monthly measurement and increase in width of rump of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	6.00	——	6	5.33	——
1	15	6.93	0.93	6	6.76	1.43
2	21	7.66	0.73	9	7.37	0.61
3	21	8.74	1.08	11	8.22	0.85
4	19	10.13	1.39	11	9.30	1.08
5	18	10.98	0.85	9	10.46	1.16
6	15	11.73	0.75	9	11.01	0.55
7	13	12.15	0.42	9	11.72	0.71
8	13	12.57	0.42	9	12.05	0.33
9	11	13.04	0.47	8	12.43	0.38
10	11	13.36	0.32	8	12.50	0.07
11	10	13.56	0.20	8	12.50	0.00
12	8	13.50	-0.06	8	12.50	0.00
13	8	13.81	0.31	7	12.57	0.07
14	8	13.87	0.06	7	12.92	0.35
15	7	13.85	-0.02	7	13.07	0.15
16	7	14.07	0.22	6	13.08	0.01
17	7	14.07	0.00	5	13.30	0.22

TABLE 6

Showing the average monthly measurement and increase in heart girth of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	30.06	——	6	29.25	——
1	15	33.43	3.37	6	33.41	4.16
2	21	38.00	4.57	9	37.32	3.91
3	21	41.64	3.64	11	41.77	4.45
4	19	45.98	4.34	11	43.86	2.09
5	18	49.64	3.66	9	47.98	4.12
6	15	52.10	2.46	9	50.22	2.24
7	13	53.26	1.16	9	51.72	1.50
8	13	55.50	2.24	9	52.94	1.22
9	11	57.86	2.36	8	54.43	1.49
10	11	58.95	1.09	8	55.12	0.69
11	10	59.85	0.90	8	55.43	0.31
12	8	60.43	0.58	8	55.75	0.32
13	8	60.87	0.44	7	56.07	0.32
14	8	61.06	0.19	7	57.28	1.21
15	7	62.14	1.08	7	57.50	0.22
16	7	62.78	0.64	6	58.66	1.16
17	7	64.28	1.50	5	59.20	0.54

TABLE 7

Showing the average monthly measurement and increase in circumference of barrel of kids in lots I and II

AGE	LOT I			LOT II		
	Number measured	Average measurement	Average increase	Number measured	Average measurement	Average increase
months		*cm.*	*cm.*		*cm.*	*cm.*
Initial measurement	15	30.13	——	6	29.41	——
1	15	33.93	3.80	6	33.41	4.00
2	21	42.68	8.75	9	41.44	8.03
3	21	49.48	6.80	11	48.38	6.94
4	19	55.43	5.95	11	52.86	4.48
5	18	61.17	5.74	9	59.66	6.80
6	15	63.03	1.86	9	61.11	1.45
7	13	63.84	0.81	9	62.44	1.33
8	13	67.00	3.16	9	64.87	2.43
9	11	69.09	2.09	8	64.87	0.00
10	11	70.81	1.72	8	65.25	0.38
11	10	70.85	0.04	8	65.87	0.62
12	8	69.00	–1.85	8	65.75	–0.12
13	8	69.06	0.06	7	68.14	2.39
14	8	68.93	–0.13	7	70.71	2.57
15	7	71.57	2.64	7	72.21	1.50
16	7	75.28	3.71	6	75.41	3.20
17	7	77.57	2.29	5	77.20	1.79

PUBLISHED CONTRIBUTIONS OF THE COLLEGE OF AGRICULTURE: VI[1]

B. M. GONZALEZ
Dean, College of Agriculture

With the publication of this number of THE PHILIPPINE AGRICULTURIST, the College of Agriculture will have completed twenty years of service to Philippine agriculture and world science. In going over the titles listed herein, as well as those published heretofore, one cannot but realize that the field of Philippine agriculture has been extensively covered. A survey has been made, as it were, of the Philippine territory, which serves three utilitarian purposes; the intrinsic value of the work reported; the ground work it furnishes for a more intensive attack; and the knowledge it has made available to the world as the Philippine contribution to the sum total of world agricultural knowledge. The years that will follow will naturally see a more intensive investigation of certain phases of the area surveyed.

That the College has acquitted itself well in the field of its endeavors cannot but be admitted. The work of the College reported mainly in THE PHILIPPINE AGRICULTURIST stands as one of the most valuable collections existing on the agriculture of a tropical country. This published material constitutes a veritable monument to the founder and first dean of the College, Dr. Edwin Bingham Copeland, and his worthy successor the late dean, Professor Charles Fuller Baker, who nurtured and encouraged the spirit of inquiry from the early beginnings of the institution. This policy is now bearing its fruits fully.

The College is about to start on its third decade of existence. Its administration is now almost entirely in the hands of its first students who imbibed the spirit from the early masters. The policy of stimulating research will therefore be continued, and if it were possible, it will be given even a greater push.

II: EXPERIMENT STATION CONTRIBUTIONS

The contributions are numbered serially as reported. For Nos. 1–199, *see* THE PHILIPPINE AGRICULTURIST XII, No. 7, December, 1923. For Nos. 200–287 *see* THE PHILIPPINE AGRICULTURIST XIII, No. 10, March, 1925. For Nos. 288–354, *see* THE PHILIPPINE AGRICULTURIST XIV, No. 10, March, 1926. For Nos. 355–440, *see* THE PHILIPPINE AGRICULTURIST XV,

[1] General contribution from the College of Agriculture No. 215

No. 10, March, 1927. For Nos. 441–517, *see* THE PHILIPPINE AGRICULTURIST XVI, No. 10, March, 1928.

(518) MENDIOLA, N. B. 1928. Important progress in sugar cane breeding in the Philippines. Cane: 15–18. *Fig. 1–4.* Published by The Provincial Carnival Association, Bacolod, Occidental Negros, Philippine Islands.

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(520) MONTINOLA, ERNESTO R. 1928. Earle methods *vs.* ordinary method of treating ratoons. Sugar News **8**: 261–279.

(521) GONZALEZ, B. M. AND J. P. ESGUERRA. 1927. Is a zebu-carabao hybrid possible? The Journal of Heredity **18**: 545–547. *Fig. 1.*

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(523) VILLADOLID, DEOGRACIAS V. 1927. The occurrence of Naobranchia occidentalis on the Pacific Coast of the United States. Journal Washington Academy Science **17**: 230–231.

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(525) *See* Circular No. 14.

(526) *See* Circular No. 16.

(527) MENDIOLA, NEMESIO B. 1928. A report on an agricultural investigation trip to Java, Federated Malay States, and Borneo. The Philippine Agriculturist **17**: 3–23. *Fig. 1–5.*

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(531) LAVA, V. G. 1928. The application of the method of least squares to the determination of the relationship between cane yields and stools per hectare. Sugar News **9**: 460–463. *Charts 1–2.*

(532) *See* Circular No. 10.

(533) RODRIGO, P. A. 1928 Studies on the correlation between the seed and straw production of some field legumes. The Philippine Agriculturist **17**: 83–87.

(534) ESPINO, RAFAEL B. 1928. Report on recuperative growth within a year of some plants injured by a typhoon. The Philippine Agriculturist **17**: 89–93. *Fig. 1-7.*

(535) SERRANO, JOSE A. 1928. A comparative study of the effect of copra meal and dried shrimps as supplements in rations for laying hens. The Philippine Agriculturist **17**: 95–104. *Chart 1.*

(536) MONDOÑEDO, MARIANO. 1928. A comparative study of corn and cassava as feeds for hogs: II. Ground corn *vs.* raw chopped cassava. The Philippine Agriculturist **17**: 105–107.

(537) GORDON, ALEXANDER. 1928. A gravity gate, or a simple self-closing gate. The Philippine Agriculturist **17**: 117–123. *Fig. 1-6.*

(538) ETORMA, SEVERINO B. 1928. Proximate analysis of some Philippine shellfish. The Philippine Agriculturist **17**: 125–133. *Pl. 1.*

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(543) Pantaleon, Feliciano T. 1928. Effects upon rice plants of changing the moisture content of soil. The Philippine Agriculturist **17**: 173–185.

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(582) Adriano, F. T. 1929. The use of steam in Kjeldahl nitrogen determination. The Philippine Agriculturist **17**: 509-510. *Fig. 1-2*

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(585) Mercado, Toribio. 1929. Sugar cane breeding in the College of Agriculture V: Isolation of live cane arrows and their use for hybridization. The Philippine Agriculturist **17**: 527-535 *Fig. 1-2.*

(586) Paller, Enrique M. 1929. The effects of dry heat on weevils in corn and on corn seed. The Philippine Agriculturist **17**: 537-549. *Fig. 1-2.*

(587) Florida Vicente T. 1929. Variability in important agronomical characters among sugar canes from parent varieties H–227, Louisiana Striped, Cebu Purple and Badila, *Abstract in* The Philippine Agriculturist **17**: 552-553.

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III. GENERAL CONTRIBUTIONS

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(216) Guanzon, G. 1929. Note: The Association of Junior Sugar Technology. The Philippine Agriculturist **17**: 643-644.

IV. CIRCULARS

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No. 15.—Villegas, Valente. 1928. Cattle raising under Philippine conditions. (See Experiment Station No. 514).

No. 16.—Sacay, Francisco M. 1928. A simple farm record for the farmer.

NOTE: THE BAKER MEMORIAL PROFESSORSHIP

A professorship in memory of Charles Fuller Baker, who was dean of the College of Agriculture from 1917 until his death in July, 1927 has been definitely established by the Board of Regents.

In September, 1927 Dr. B. M. Gonzalez, Dean of the College of Agriculture recommended to the Board of Regents that the salary of Dean Baker, ₱9,000 ($4,500), be continued indefinitely for the financing of a chair to be designated as the C. F. Baker Memorial Professorship in Agriculture. In presenting reasons for this recommendation Dean Gonzalez stated that, "The benefits that will accrue to our faculty from the very intimate contact with a new intellectual leader every year will be tremendous. These men coming from abroad with the latest ideas on their subjects will also bring to our work a new point of view which cannot but be beneficial."

The Board of Regents in establishing the professorship makes the conditions that "₱6,000 ($3,000) of the amount will be used as salary for the incumbent, who shall be in residence in the College for not less than eight months and who shall carry a teaching load of not less than five hours a week". The Board set aside the remaining ₱3,000 ($1,500) "to cover the travel expenses of the incumbent from his home to the Philippines and for his return. Whatever remains of the ₱3,000 shall be available to him for travel within the Islands.

It is realized that the salary this memorial professorship carries is wholly inadequate to secure the services, for the short period of a year, of men qualified to be of value to the College. It is hoped, however, that it is enough to secure men who are on sabbatical leave, or who for the experience and opportunity for study and observation in the Philippines for a year would welcome an appointment which carries at least full expenses both for travel and living.

The Los Baños region has been pronounced by botanists and zoölogists of wide experience to be one of richest and best known biotic groups in the world. For agronomists interested in the tropics the Philippines has much to offer. Also, the privilege of working in what is perhaps the best equipped Agricultural College in the orient should be an inducement;—to this privilege is added the convenience of the laboratories and scientific libraries in Manila.

For the faculty of the College and for groups of advanced students in the line of each man's specialty, the advantages of this professorship cannot be estimated. Infusion of new ideas or new presentation of old is quite as beneficial in an institution as infusion of new blood in animals. The presence each year on the Campus of a man from another institution, one who is a recognized authority in his line will be an inspiring influence, especially for our men who are engaged in research. For these men from abroad will bring to the College their knowledge enriched by experience, the enthusiasm that a new field always arouses; fresh interest in this very new country,—and above all each will come fired with a zeal to make his stay in the College of real worth.

In establishing the Baker Memorial Professorship the Board of Regents has paid a fine tribute to a man who gave to the College and the country service of worth beyond calculation; and has opened a possibility for benefit to the College of Agriculture that cannot be visioned.

EL HERBARIO, PROFESOR CHARLES FULLER BAKER

RESOLUCIÓN

Por cuanto: En 22 de Julio de 1927 falleció en las Islas Filipinas el eminente Botánico y Biólogo Sr. Charles Fuller Baker, Dean de la Universidad de dicho Pais, el que prestó por espacio de largo tiempo valiosos servicios a la República en la recolección, estudio y clasificación de su Flora, fundando el magnífico Herbario que posee la Estación Experimental Agronómica de Santiago de las Vegas y restaurando el Herbario "Sauvalle" propiedad de la Academia de Ciencias, de cuya institución era Miembro Correspondiente,

Por cuanto: El Director de la Estación Experimental Agronómica citada, a solicitud del Sr. Miguel Zarragostia, ha propuesto como medio de perpetuar su memoria que se dé su nombre al Herbario de dicho establecimiento,

Por cuanto: En uso de las facultades que me están conferidas,

Resuelvo:

Primero: Disponer que se dé el nombre de "Profesor Charles Fuller Baker" al Herbario existente en la Estación Experimental Agronómica que con tanto saber y diligencia fundó y contribuyó a enriquecer el eminente sabio de este nombre; y comisionar al señor Director del citado Establecimiento para que notifique esta resolución a sus familiares, por conducto de la Universidad de las Islas Filipinas.

Segundo: El Sr. Subsecretario del Rama queda encargado del cumplimiento de la presente.

Dada en la Habana a veinticinco de Octubre de mil novecientos veintiocho.

Dr. E. Molinet,
Secretario de Agricultura, Comercio y Trabajo.

—*Revista de Agricultura, Comercio y Trabajo,* (Habana, Cuba).

[*Translation*]

THE CHARLES FULLER BAKER HERBARIUM

RESOLUTION

Whereas on July 22, 1927, death claimed in the Philippine Islands the eminent botanist and biologist, Charles Fuller Baker, dean in the University of that country, one who for a long time rendered valuable service in the (Cuban) Republic in the collection, study and classification of its flora, founding the magnificent herbarium of the Agricultural Experiment Station of Santiago de las Vegas and restoring the Sauvalle Herbarium of the Academy of Sciences, of which organization he was a corresponding member;

Whereas the director of the aforementioned Agricultural Experiment Station, at the instance of Sr. Miguel Zarragostia, has proposed, as a means of perpetuating Dean Baker's memory, that the herbarium of that institution be named after him;

Therefore, in the exercise of my legal powers,

It is Resolved:

First that arrangements be made that the name of Charles Fuller Baker be given to the herbarium of the Agricultural Experiment Station, which the eminent savant by that name founded and helped enrich with such knowledge and diligence; and that the director of that institution be commissioned to bring this resolution to the attention of his colleagues, through the University of the Philippines;

Second that Mr. Subsecretary del Rama is hereby entrusted with carrying out this resolution.

Given at Habana this twenty-fifth day of October nineteen hundred and twenty-eight.

Dr. E. Molinet,
Secretary of Agriculture, Commerce and Labor.

NOTE: THE ASSOCIATION OF JUNIOR SUGAR TECHNOLOGISTS

If one not familiar with the College of Agriculture should visit the campus in January or February, his attention will be attracted to a peculiar College building bearing in large letters the name "U. P. Sugar Mill." Curiosity may lead him to its interior where he will see not a lecturer before a class but embryo Sugar men at work on their first lesson in making centrifugal sugar from sugar cane. These students are the "Sugar Techs". In October 1922 under the guidance of Professor Henares the students in this course organized the Association of Junior Sugar Technologists, a vest-pocket edition of the Philippine Sugar Association.

The primary object of this association, of course, is to learn how to produce the best grade of cane sugar in maximum quantity. Even as sugar is used in various ways in various places, the "Sugar Techs" vary their activities. It is no exaggeration to say that the completion of the construction of the U. P. Sugar Mill in 1922 would have been much delayed had it not been for the help rendered by the "Sugar Techs". Besides working in the mill without compensation, the members of the association voluntarily worked to raise funds by cine benefits to give the finishing touches to the mill.

A NIGHT IN ALCHEMY

Staged by the Junior Sugar Technologists, College of Agriculture, August 18, 1928.

This was the first noteworthy act of the association. The first drama on a scientific subject ever written and presented in the College of Agri-

culture was by the "Sugar Techs." This memorable production, "In the Kingdom of the Sugar Technologists" was staged on August 13, 1925, on the lawn in front of the Sugar Mill. The latest dramatic stunt of the society was the celebration of Sugar Tech Day with a program on August 18, 1928, in the College Auditorium and with a dance at the Philippine Columbian Club, Manila, in the evening of August 25. Dr. Manuel L. Roxas was the guest of honor. Among the features of the program were a vocal solo by Miss Raquel Abelardo of the Conservatory of Music, "Discovery Announcement of the Newest Element (Woman, Wo)" by E. Sitchon, an illustrated lecture on an unpatented invention, "Science Has Cured Sleepiness in the Classroom", by W. Pangan; and remarks by Dean Gonzales in which he laid emphasis on the importance in this country of the Sugar Technology course. The novel feature of the evening was a chemical pageant, "A Night in Alchemy," written by R. D. Billinger and published in the *Journal of Chemical Education.*

The pageant was an excellent portrayal of the wonders of alchemy. The sudden appearance on the darkened stage of a luminous human skull; the production of fire from ice and water; the discovery of the secret messages of the builders of the great Egyptian pyramids; and the appearance of the famous Cleopatra's serpent from a piece of crayon gave the mystified audience something which held them breathless in wonder and suspense. The cast was composed of:

Subtle, an Alchemist.....Julian Gomeri
Lungs, the Alchemist's valet.....Francisco Gomez
Gobbo, a wanderer who also practices
the black art.....Cayetano Ramos

The officers of the Association for the College year are: President, Enrique Hemedes; Vice-President, Manuel Hollero; Secretary-Treasurer, Ernesto Jamora; Athletic Manager, Cornelio Lemoncito; Editor, Rafael Rotor; and Faculty Adviser, Dr. Vicente G. Lava.

The importance of being a "Sugar Tech" is keenly realized by many aspiring students from all parts of the Islands, as is shown by the increasing number of applicants for the course every year. Also, several graduates from the general course have taken the courses in Sugar Technology, thus practically converting it into a sort of a post-graduate course. The need for Sugar Technology in this College is further demonstrated by the fact that all the "Sugar Tech" graduates are employed in sugar centrals in Negros or Luzon. Moreover, the Sugar Technology Division was asked this year to fill nine more technical positions in sugar centrals than there were graduates from the course.

Attraction for the course has been further augmented by the Bailon-de la Rama scholarship which is effective in 1929. This scholarship is for the best "Sugar Tech" selected by competitive examination. Julian Gomeri a sophomore won the first of these scholarships.

G. Guanzon,
Of the Department of Agricultural Chemistry.

ABSTRACT[1]

A Fusarium bulb rot of onion. Enrico B. Gamo. (*Thesis presented for graduation from the College of Agriculture No. 284; Experiment Station contribution No. 595*).—The author describes the *Fusarium* bulb rot of onion that was first noted in the College Experiment Station at Los Baños in 1925. Much damage from the same cause was said to have been noted in one of the onion fields of Batangas. The disease is said to be due to a fungus which resembles in many ways *Fusarium udum* (Berk.) Wr., a saprophytic species, of the Section Eupionnotes. Externally, the diseased plant manifests rapid drying of the leaves from the tips. Then the bulb becomes soft and eventually rots. The fungus penetrates intracellularly into the host tissues. The mycelium is granular, vacuolate while young, but empty when old. The septate conidiophores produce conidia at their tips. The macroconidia are typically dorsiventral, generally 3-septate, and hyaline with slight tinge of green. The microconidia are nearly pear-shaped to ellipsoidal, non-septate, and hyaline tinged with slight green. Upon germination, the macro- and microconidia each produces two germ tubes—one at the hilum and another at the apical end. In culture true pionnotes are formed. The chlamydospores may be intraconidial, terminal, or intercalary. The intraconidial and terminal chlamydospore are borne singly. The former are abundant, spherical, and produce germ tubes on germination. The latter are of rare occurrence. The intercalary chlamydospores are borne either singly or in chains. The expressed onion juice prevents the germination of the spores of the fungus. Experiment with "sick soil" and damp-chamber inoculations manifested that the *Fusarium* onion bulb rot may infect Bombay and Tagalog onion varieties. The fungus may be disseminated by man and animals—in decaying plant materials, debris, and soil. Crop rotation, curing, and storing in cool, dry chambers are recommended for the control of *Fusarium* bulb rot of onion.

—*Abstract by Pascual Robin.*

EXCHANGE NOTES

One of the most active club boys in Iowa is Fred Schneider of Goodell. Fred has a record that is envied by many, and in reading it, it sounds like an American Magazine story. This is Fred's story:

"I have been a member of the Hancock Baby Beef Club for five years. I have always had good success with my calves and last year my calf won

[1] Abstract prepared as part of required theme work in English 6, College of Agriculture.

grand championship at our county fair. During this time I have attended the Club Congress at Chicago and have twice attended the Junior Short Course at Ames. I have also been on the judging team for two years.

"Club work is a wonderful thing and has helped me in many ways. I think one of the best results of club work is that it teaches you to take defeat as well as victory. This will mean much in later life, as one must meet with both. This is my last year in club work. Next year I expect to enter college. My experience in club work will benefit me very much there. Club work not only gives one the working side of life, but also the social side. There are club tours, trips and other events where you become acquainted with other people and learn their ways and that is what makes success—using other ideas with your own.

"It takes a lot of time, work and patience to succeed, but in the end you will see the good of it and it prepares you for the future with a clearer view of life and a more determined personality.

"There are many ways in which club work can be improved, but time will solve these difficulties. Good leadership, hard work and encouragement will keep it going and keep it doing its job of preparing young folks for future citizens."

—*Iowa Agriculturist* (Iowa).

Vitamins have not as yet been chemically identified, but it has been found that they are essential to normal growth and maintenance.

Vitamin A.—Fat soluble and necessary for growth, found in butter, milk, liver, codliver oil, and leafy vegetables such as cabbage, spinach, etc., also in egg-yolk, carrots, kidneys.

Vitamin B.—Water soluble, prevents Beri-Beri, found in yeast, dried beans, fruits, egg-yolk, peas, nuts, whole grain cereals, vegetables, milk.

Vitamin C.—Prevents scurvy; found in oranges, lettuce, tomatoes, green peas, spinach, cabbages, potatoes.

Vitamin D.—or Calcium-depositing vitamin, prevents Rickets—it is found in cod-liver oil, cocoa-nut-oil, shark-oil.

—*Farming in South Africa.*

A party of American soil experts and representatives of fertilizer interests visited Europe the past summer to see what Europe was doing in the fertilizing field. Following is their summary of what they saw:

Europe is a treasure house of valuable and interesting information, historically and practically. Historically, because it is the birthplace of soil science and has played so large a part in its development; practically, because it has shown the way, on fields that have been under cultivation

for more than two thousand years, to the upbuilding of a superior soil fertility as indicated by crop yields far surpassing those on our own practically virgin land.

—*The Fertilizer Review* (Washington, D. C.)

Long dry weather, when the ground becomes infested with droppings, is conducive to the outbreak of different diseases [among fowls], and there is generally a good crop of yaws and "fowl sick." Keep Epsom salts going in the water and Permanganate of Potash. The Epsom salts need not be given every day, but every third day, the Permanganate of Potash meanwhile. . . . When fowls are once attacked by what is called "fowl sick" it is hardly any use trying to treat them, and even if a fowl is treated, and an occasional one recovers, it is not much use afterwards. The first symptoms of "fowl sick" are, the fowl gets off the roost late, it sits in a corner and refuses food, and gradually dwindles away. When these symptoms occur, it is far better to kill the fowls than to try to treat them, or let them stay until they die.

—*The Journal of the Jamaica Agricultural Society.*

People of the United States are now consuming about 4.36 pounds of cheese per capita annually as compared with 3.5 pounds in 1921, according to the United States of Agriculture. In Switzerland the per capita consumption is approximately 23 pounds; in France, Denmark and the Netherlands approximately 13 pounds; in Germany 9.5 pounds; and in Great Britain 8.9 pounds.

—*The Prairie Farmer.*

In Kashmir State, located at the extreme border of northwestern India, even in this age of modern transportation a cart frequently is pulled more cheaply by a half-dozen men than by a pair of oxen or horses. Embracing an area of 84,258 square miles, it lies among the Himalayas, the great central range of which divides it into two parts.

—*Commerce Reports* (U. S.)

It costs less to cultivate a fertile soil than it does an infertile one. The total cost of raising the crop may be slightly higher due to the increased cost of harvesting but the cost per bushel or unit is much less for a crop of high yield than for a crop of low yield.

—*California Cultivator.*

The Bridal Orange Blossoms: Origin of Custom

When Spain was at the height of her power, a Moorish chieftain, wishing to curry favor with the Spanish monarch, sent him with all pomp and ceremony an orange tree as an emblem of fruitfulness and sincerity.

The French ambassador at the Spanish court, an astute statesman, hearing of these wonderful trees, and how quickly the fruit grew on them, desired to possess one. He discovered that, unknown to her father, the daughter of the royal gardener—a pretty, dark girl—was deeply in love with a young man, who, however, was comparatively poor, so that they could not marry.

The French noble, fearing that an attempt to bribe the gardener might be unsuccessful, approached the daughter, telling her that if she could obtain a small plant for him, he would give her a large sum of money. The girl assented, and when the plant was handed to the ambassador he paid her so liberally that the lovers were able to marry and purchase a farm for themselves. On her marriage day, the happy bride entwined orange blossoms in her hair in remembrance of her good fortune.

The Frenchman sent the plant to his estate in the south of France. In due course of time he was able to present a tree to the King of France, and a little later one was introduced into the Royal Garden of England.

When the story of the Spanish girl came to be known, the flowers began to be used as bridal wreaths and decorations, but for a long time they were so expensive that only the wealthy could indulge in their use.

Thus reads the story of the origin of the Orange Blossom Wreath worn at weddings.—*A. L.*

—*The American Florist.*

COLLEGE AND ALUMNI NOTES

Mr. William Thompson, popularly known as "Pussy-foot" Johnson, a modern crusader for world-wide prohibition, addressed the Student Body on January 10.

Anastacio L. Teodoro, B. Agr. '18, who, as government pensionado, has been studying in the United States for past two years has returned to the College. Mr. Teodoro studied in Cornell University, majoring in mechanical engineering. He received the degree of Doctor of Philosophy in June, 1928.

Before returning home, Doctor Teodoro traveled in Cuba, England, France, Belgium, Germany, Switzerland, and Italy with mechanical engineering as his special object of observation. From Europe he returned to the Philippines via Suez.

Doctor Teodoro was appointed Acting Head of Department of Agricultural Engineering on his return to the College.

Poultry Raising by F. M. Fronda, in charge of the Poultry Division in the Department of Animal Husbandry, is just off the press. Doctor Fronda

has written a practical text book of 269 pages to which the 69 illustrations add attractiveness. The book should be invaluable as a text in Philippine farm schools and as a guide for the individual poultryman. The Oriental Commercial Company, Inc. of Manila is the publisher.

The Los Baños Biological Club held its fortieth scientific meeting in the College Auditorium on December 13, 1928.

The following papers were read and discussed.

Ancestry of important College seedling cane varieties as suggested by Jeswiet characters.

By Dr. N. B. Mendiola.

Studies on the development of *Cercaria dorsocauda.*

By Dr. M. A. Tubangui.

Observations made on some coconut plantations in the Visayas.

By Mr. M. M. Kalaw.

The U. P. Sugar Mill started milling on January 15, 1929.

The following Sugar Technology seniors are now working in Sugar Centrals for their Mill Practice B (STech. 7):

Federico Isaac, in Pampanga Sugar Mills
Agustin Hermano, in Bacolod-Murcia
Enrique Hemedez, with Pampanga Sugar Development Co.
Agustin Luzuriaga, in Ma-ao Sugar Central
Ernesto Jamora, with Binalbagan Sugar Co.
Manuel Villano, in Pampanga Sugar Mills
Elias Eubanas, in Isabela Sugar Central.

The Christmas season was not gloomy for the students remaining on the Campus. One evening a group of about forty under the leadership of Miss Thuman and Miss Cole sang Christmas Carols in all the Student barrios, the Coconut Grove, in front of student bungalows, dormitories, "Y", faculty homes—both on lower campus and Faculty Hill. Singing Christmas Carols is a beautiful custom and it is hoped that the success of this first "Caroling" will lead to its repeating each year. The singing was good. As the music of old, old, well loved carols rang over the Campus, it brought to all, singers and listeners, the solemn sweetness of Peace on Earth, Good Will to Men.

A Christmas tree with a gay toys for each student, was the feature of the annual Christmas party given for the students by the faculty.

On Christmas night under the leadership of Rev. Hugh Bousman and Miss Cole about one hundred students had a jolly evening playing games in the Auditorium.

Mr. Francisco Palad, Assistant in Chemistry, was married to Miss Correa Adia of Urdaneta, Pangasinan, last December 26, 1928.

By request the Mimics repeated "The Twelfth Commandment" on the evening of January 12. The general verdict was that the cast surpassed their first very excellent performance.

On February 16 the Mimics closed a successful year with "The Cadets' Sweethearts"—a musical production written and arranged by Miss Anne F. Cole, the club director. This production was clever, jolly, altogether delightful and admirably presented. Centering around a big soccer football game with Manila U. P. team Cadet Songs, rally songs and all that goes with "pep rallies," gave a jolly bit of student life. The two pairs of sweethearts brought in the necessary "love element". And most skillfully were the old songs and old tunes with new words woven into a story of student life. From the opening scene with Captain José singing to violin accompaniment, the old classic "Believe me" to his sweetheart, Maria, as she broke through a huge red heart, to the closing scene—which was the double wedding (military) of Jose' and Maria, and Juana and Pedro, it was a charming gay bit. The wedding was told to audience by the familiar strains of Lohengrin March played back stage on an organ by Professor Roa. Then as the church doors opened to the strains of the Mendelssohn Wedding March came the two bridal couples under the traditional arch of crossed sabers. With Schuberts "Song of Love" by the Cadets and brides the curtain fell. Mention cannot be made of one scene, of one song—all were so well given, so well sung, both solos and choruses.

From every standpoint, in conception and construction and in presentation the play merits high praise.

And warm words of praise are due Mrs. Hugh Bousman, the musical director, for her splendid cooperation and generous giving of her ability.

THE CADETS' SWEETHEARTS

Written and arranged by ANNE F. COLE

(Many familiar songs used in whole or in part to help tell the story)

CAST OF CHARACTERS

José—Cadet Captain		Fernando Fernandez
Maria—His Sweetheart		Maria Villadolid
Pedro—His Chum		Honorio Ylizardo
Juana—Pedro's Sweetheart		Mamerta Manahan
Juan—José's Rival		Onopre Casupang
Francisco—Juan's Friend		Ruperto Ami
Antonio—Cadet Rooter King		Sabas Tangco
Julio—Clown of the Cadet Corp		Honorio Reyes
Primo	Cadets	Loreto Rivera
Honorio		Valentin Amon
Leon		Vicente Fernandez
Angel		Domingo Tugade
Santos		Jacinto Antonio
Sebastian		Francisco Sipin
Gregorio		Hermenegildo Farolan
Felix		Eugenio Avanceña

"The Cadets' Sweethearts'—Overture

ACT I

Songs

(Minor songs not listed)

Believe Me If All those Endearing Young Charms - - - - - - - - *José*
Love is Just a Game - - - - - - - - - - - *Maria, José and Cadets*
Juana, Juana, I've Been Thinking (Adapted) - - - - - - *Juana and Pedro*
Juan's Lament (Old tune) - - - - - - - - - - - - - *Juan*
I Passed by Your Window (Adapted) - - - - - - - - - - *Pedro*
Stand Beneath Our Colors - - - - - - - - - - - - *Cadets*
The Game (Old tune) - - - - - - - - - - - - - - *Angel*
Good Bye Manila (Old tune) - - - - - - - - - - - *Antonio*
The Love Nest - - - - - - - - - - - - - *Maria and Juana*
I'd Love To - - - - - - - - - - - - *Juana, Pedro and Cadets*
Song of Love - - - - - - - - - - - - *José, Maria and Cadets*

CURTAIN

Medley—The Cadets' Sweethearts

ACT II

Just Been Wond'ring All Day Long - - - - - - - - - - - *Juana*
It Takes a Girl to Do it Every Time (Old tune) - - - - - - - - *Juana*
They're Always Abusing The Women - - - - - - - - - - *Juana*
(Words from a Greek play by Aristophanes)
Deep in My Heart, Dear - - - - - - - - - - - - *José and Maria*
And The Romance Ends Right There (Adapted) - - - - - *Honorio and Cadets*
The Bachelor's Song of Freedom (Old tune) - - - - - - - - *Julio and Cadets*
Song of Love - - - - - - - - - - - - - - - *Grand Finale*

INDEX

VOLUME XVII

JUNE, 1928 TO MARCH 1929

A

Abacá investigation, 110
ABBOTT, J. B., S. D. CONNER, AND H. R. SMALLEY, cited, 607
ABESAMIS, A. P., cited, 174
Abo, *see Johnius belengeri*
Absentee landlords, 326
Achimenes sp., 22
Acids
  amido, 565
  nitric, 565
  organic, 565
Achras sapota, 22
ADAMS, FRANK, cited, 579
ADRIANO, F. T. The use of steam in Kjeldahl nitrogen determination, 509
ADRIANO, F. T., AND E. J. TAVANLAR, cited, 253
AHRENS, B. A., cited, 103
Albizzia
  chinensis, 21
  lebbek, 90, 91
  stipulata, 21
Aleurites moluccana, 21
Alimañgo, 130
Alimasag, crab, 126
ALLAS, T. P., cited, 166
ALLEN, E. W., cited, 367
Allium cepa
  A Fusarium bulb rot of, in the Philippines, 301, 647
    causal organism of, 303
    morphology, 304
    mycelium, 304
    pionnotes, 310
    pot inoculation with, 311
    proof of pathogenicity, 311
    control of, 315
    economic importance of, 302
    history and geographical distribution of, 301
    symptoms of, 302
Aluminum
  a determining factor in soil acidity, 607
  chloride, 607
  harmful effects of, 612
  ion, 607
  nitrate, 608
  salts
    influence of concentration of, 612
    toxicity of, 607
    sulfate, 607, 608
Amaranthus sp., 22
Ammonia, distillation of, 509
Ammonium
  alum, 608
  nitrate series, 38, 39
  nutritive values of different salts of, 37
  phosphate series, 38
  salt series, best cultures from each of the, 40
  sulfate series, cultures in, 40
Ampullaria vittata, 126, 127
Anabas testudineus, 255
Anak-bat, 254
Ananas comosus, 22
Anchovy, *Anchovia commersoniana*, 254
Angitia punctoria, 398
Animals
  breeding, seasonal activities of, 477
    Indian blood, 625
    milking does, 625
    non-milking mothers, 625
Aninapla, *see Albizzia lebbek*
Association of Junior Sugar Technologists, note on, 645
Ants, in German forests, valuable help, 383
Apahap, *see Umbrina russelli*
Arachis hypogaea, 22, 83
  cuttings, germination and rooting of, 521
  varieties
    C. N. 3077, 86
    Kinorales, 84, 86, 519
    Lemery, 84, 86, 519
    Spanish C. N. 3077, 84, 86
    Tarlac, 86, 519
    Zambales Lupog, 86
  yield
    pod, 522
    straw, 522

Arca granosa, 128, 129
Aristolochia sp., 22
Arius spp., 254
Artocarpus
integra, 22
rigida, 22
ASDELL, S. A., cited, 478
Association, Japan Nutrition
organization, 221
source of income of, 221
ATWOOD, HORACE, cited, 511
Avian disease, contagious
autopsy of birds affected by, 264
symptoms of, 263
transmission of, 264
treatment, 264
AYRE, E. E., cited, 165
Ayuñgin, *see Pristopoma hasta*

B

BABCOCK, S. M., mentioned, 269
Baclaran poultry farm, 263
BACON, C. A., cited, 488
BAERG, W. J., mentioned, 383
Bagoong, 254
BAILEY, LIBERTY HYDE, mentioned, 211
BAKER, C. F.
cited, 223, 499
coöperation, 115
Dean, 4
entomological collection, disposition of the, 199
memorial fund, 109
mentioned, 476
professorship, 641
Bakoko, *see Sparus calamara*
BALAGTAS, AMADO N. The chemical composition of Philippine fishes, 253
Balakwit, *see Strobus canarium*
Banak, *see Mugil cephalus*
Bandoeng, exposition at, 5
Bangilan
coffee estate, 14
government coffee estate at, 5
Bangelus, *see Chanos chanos*
Bañgos, *see Chanos chanos*
BANKS, CHARLES S., cited, 398
Barit, *see Leersia hexandra*
Barong, *see Pinna vistaga*
Barred Plymouth Rock, 263
BARRETT, O. W., cited, 223
Bastard shad, *see Konosirus thrissa*
BEHRENS, J., cited, 565
Berk-Jalas, College bred, 105
BERTUS, L. S., cited, 223, 225, 226, 230, 231, 232
Besugo, *see Pomadasis argyreus*
Biang-puti, *see Glossogobius giurus*
Biang-sudsod, *see Platycephalus indicus*
Bigatan, *see Arca granosa*
Biñga, *see Melo aethiopica*
Birds, early, in experimental chicken, 514
Bitubituin, 127
BLISS, R. K., AND C. B. LEE, cited, 368
BLOKZEIJL, K. R. F., cited, 593
BOLIVAR, SALVADOR F. A study on the preparation of hog ration as related to growth and development of pigs, 367
Bordeaux mixture for control of coffee rust, 79
Botys
lupulina, 397
luputinalis, 397
nubilalis, 397
silacealis, 397
zealis, 397
BRAUN, H., cited, 500
BRITT, J. B. Vocational teacher of agriculture in North Carolina, 275
Buan-buan, *see Megalops cyprinoides*
Bubalus bubalis, 169
Buffaloes, the trend of reproductive season of water, 482
Buffer solutions, antimony electrode in, 337
Bugaong, *see Therapon puta*
Bugs, collection of, 200
Buguing, *see Hemiramphus* sp.
Buitenzorg, 4
central rubber experiment station at, 16
organization of the general experiment station at, 10
tea experiment station at, 16
BULIGAN, CATALINO T. The corn borer, *Pyrausta nubilalis* Hübner (Pyralidae, Pyraustinae, Lepidoptera), 397
Bundaqui, *see Ophicephalus striatus*
BUSCK, A., cited, 223

C

Caesio, or dalagang-bukid, *see Caesio chrysozona*
Caesio chrysozona, 254
CAFFREY, D. J., cited, 398
CAFFREY, D. J., AND L. H. WORTHLEY, cited, 398
Calendra
granaria, 542
oryzae, 537
Calopogonium muconoides, 21
Caligay, snails, 127
CALMA, VALERIANO C., LORENZO G. PADERNA, AND MACARIO A. PALO.
A study of certain chemical treatments in relation to seed-borne diseases of Calauan Yellow Flint maize, 499
Camot pusa, *see Circe gibba*

Cane breeding garden at Blambagan, 5
Cane breeding, Jeswiet hair groups in, 279
Carabao
  Cooperia in, 169
  Indian buffalo, 478
  morbid anatomy of, 169
  native carabaos, 478
Caranx malabaricus, 258
Carbon
  assimilation of, 608
  bisulphide, 537
CARD, LESLIE E., cited, 511
Carnivals, provincial, 51
Cassava
  breeding of, 11
  grater, 593
Cas-sisung, *see Scomberoides tol*
CATAMBAY, ALEJANDRO B. Comparative wear of certain metals and alloys used in plows and disk harrows, 487
  cited, 26, 30
Catfish, *see Clarias batrachus*
Cattle
  Nellore and Hereford breeds, 478
  the trend of sexual reproductive seasons of, 480
CAVANAUGH, GEO. W., mentioned, 510
Centrosema pubescens, 21
Cerithium vertagus, 126
Chanos chanos, 257
Chicken
  scaly legs of, and control, 562
  weanling and yearling, 515
  weights of individual, 511
  White Leghorn, 512, 513
Chickens, Cantonese, 263
  "Improved Los Baños", 560
  relative cost of feed used and of eggs produced by, 100
Chicks, Cantonese, 512, 515
  mortality of, 102
  observation of, 97
  weight and growth of, 102
CHITTENDEN, F. H., mentioned, 537
Chloride and SiO_2, 566
Chrysobothris dentipes, 538
Cigarettes
  alcohol extracts, 570
  American manufacture, 565, 569
  petuning substances in, 571
  comparative analysis of American and Philippine, 565
  extractable substances, 565
  Philippine, 565, 567, 569
  polyphenols in, 566
Cinchona, 22
  plantations in Java, private, 18
Circe gibba, 129
Clarias batrachus, 255
CLARK, W. MANSFIELD, cited, 339
Climbing perch, *see Anabas testudineus*
Coconut, *see Cocos nucifera*
Cocos nucifera
  a study on the growth of, 361
  brooms, 166
  brushes, 166
  bukayo, 164
  buko, 164
  coir fibers, 166
  drying problems in Leyte, 467
  endocarp of, 362
  endosperm of, 362
  flower, spathe of, 167
  gray spot, or blight of
    causal organism of, 223
    economic importance of, 223
    symptoms and signs of, 223
  hard shells of, 362
  husk, mops from, 166
  latek, 164
  leaves, palaspas from young, 163
  leaves for wrapping suman, 164
  mesocarp of, 364
  mops, 166
  products, chemical studies on, 163
  shell and husk, 166
  toddy, 167
    beverage from, 167
    palm sugar from, 167
    vinegar from 167
  twine, 166
  uses of nut, roots, trunk, and leaves of 163, 164
  water, 166
Coffea spp.
  and rubber experiment station, Malang, 5, 16, 20
  beetles, 80
  berries, 77, 78
  Cercospora disease, 179
  commercial varieties, 14, 66
  crickets on, 80
  diseases and pests, 79
  distancing of, 72
  Hemileia vastatrix on, 79
  hybrids, 14
  improvements of, 14
  maximum production of quality, 65
  monkeys and cattle damage to, 80
  notes on yields of some species of, 317
  planting of, 65, 72
  plantation
    catch crop for, 77
    cultivation of, 76

climate of, 66
elevation of, 65
estimate of opening one hectare of, 80
good land for, 65
holing, 72
liming, 72
preparation of, 72
proximity to river, 66
selecting land for, 65
shelter for wash and wind, 66
weeding of, 75
pruning, 76
resistance to the rust of, 45
scale insects on, 80
seed bed and nursery
location of, 68
planting in the nursery beds, 69
planting the seeds, 69
preparation of, 68
shading the beds, 69
seed selection and preparation of seeds for planting, 68
shade for, 73
transplanting of, 70
variety to plant, 67
watch dog for keeping, 80
Coffee, *see Coffea* spp.
Cohn, Robert, cited, 165
Cohol, *see Ampullaria vittata*
College and alumni notes, 55, 113, 158, 209, 271, 329, 390, 470, 555, 648
College of Agriculture
class of 1928, 56
contributions of,
circulars, 640
experiment station, 635
general, 639
Collins, A. L., mentioned, 491
Congress
agricultural, the eighth, 386
International Entomological, importance of, 384
Conner, S. D., and O. H. Sears, cited, 607
Consumer, taste of, 565
Cook, C. M., cited, 225
Coöperation, 115
Cooperia in carabao, 169
Copeland, E. B., cited, 233, 361, 593
Copra cake, 165
Corn, *see Zea mays*
Corn and cassava as feeds for hogs, 105
Cortez, Felipe. Gray spot, or blight of coconut, 223
Cover crop, 21, 51
Cowpea, *see Vigna sinensis*
Cowpea varieties, 84, 85, 86
Crab, 126
Cramer, P. J. S., mentioned, 4
Croaker, *see Johnius belengeri*
Crop
annual selection of, 4
farm, experiment, effect of borders in, 385
farm, production, selecting land for, 155
working of the sections for annual and perennial, 11
Crops, perennial, section for, 14
Crossing of varieties, 14
Crotalaria
anagyroides, 21
usaramoensis, 21
Crucillo, Cornelio V., cited, 95
Cruz, H., cited, 289
Cuzner, Harold, mentioned, 593
Curves, probable irrigation, 583
Cutter, bolo, 187
Cyrena gigantea, 128

D

Dalag, *see Ophicephalus striatus*
Dalagang-bukid, *see Caesio chrysozona*
Dangilan, Luis J., cited, 102
David, Pedro A.
Note: Introduced coffees lose resistance to the rust fungus, *Hemileia vastatrix* Berkeley and Broome, 45
Practical directions for coffee planting, 65
Dean, George A., cited, 537, 539
Dean Russel, 4
Derecho, Antonio, cited, 95
Diet
importance of fish in, 253
therapy, clinical division for, 216
Disks
Brinell hardness, 489
penetration, 488
Dean, R. W., cited, 538
Does, non-milking, 625
Drake, C. J., cited, 422
Drepane, or mayang, *see Drepane punctata*
Drepane punctata, 255
Driberg, C., cited, 255
Drum, *see Umbrina russelli*
Duggar, B. M., cited, 225

E

Eala, Quintin A., cited, 291, 293
Echocerus cornutus, 538
Eclipse of May 9, 1929, 465
Education
agricultural, in the United States, 557
vocational, 1
Egg production, the seasonal distribution of, 25
distribution curves of, 26, 29
normal curve, 25

percentage of, 25
seasonal distribution of, 25
varies with different seasons, 25
EIDMAN, H. A., mentioned, 383
Electrode
antimony in buffered and unbuffered solutions, behavior of, 337
preparation of, 338
theory regarding the behavior of, 342
non-gas, 337
ELY, RICHARD T., cited, 288
EMBODY, G. C., cited, 95
Encarsia flavoscutellum, 20
ENERVA, EPIFANIO, cited, 102
Ephestia kuehniella, cited, 538
Epicrisis, 170
Erythrina fusca, 46
ESPINO, R. B., cited, 37
Report on recuperative growths of plants injured by typhoon, 89
ETORMA, SEVERINO B. Proximate chemical analysis of some Philippine shell fish, 125
Eulimnerea crassifemur, 398
EVANS, ARTHUR T., AND M. FOWLDS, cited, 188
EWING, P. V., AND E. R. SPENCE, cited, 166
Exchange notes, 53, 111, 156, 208, 269, 327, 388, 468, 553, 647
Extension division notes, 51, 110, 154, 203, 267, 325, 386, 467
Extension service
of America, 269
relative importance of, 268

F

FARADAY, MICHAEL, 116
FABELLA, JOSÉ, mentioned, 215
FANDIÑO, J. BUENO F. A study on the growth of coconut, 361
Farmer's future, 1
Farmers, dirt, 326
Federated Malay States, 5
Feeds
concentrates, 627
dry mash, 512
grit, 512
oyster shell, 512
roughage, 627
Fehling's solution, 566
FELT, E. P., mentioned, 383
Fields, 580
preparation of, 582
soil condition of, 492
Fishery resources of the Philippine Islands, 254
Fishes, Philippine
chemical composition of, 253
methods of analysis of
ash, 259
calorific value, 260
carbohydrates, or nitrogen free extract, 260
crude fats, 260
crude fiber, 259
edible portion, 259
moisture, 259
nutritive ratio, 260
proteins, 259
sampling, 259
Flathead, *see Platycephalus indicus*
Fleas, known species of, 382
Flocks, egg records of, 26
FLORIDA, VICENTE T. Variability in important agronomical characters among seedling canes from parent varieties H-227, Louisiana Striped, Cebu Purple, and Badila, *abstract by* José O. CRUZ, 552
Flounder, *see Pseudorhombus neglectus*
Food, values of substitute, 216
Forages for Philippine horses, selection of, 600
FORBES, STEPHEN A., mentioned, 542
Forest cleaning, 203
FOSTER, M. Nature, 52
Fourth International Congress of Entomology at Cornell University, 381
Fowl, the Nagoya, a dual purpose, 559
foundation stock of, 560
Japanese standard for, 563
points in favor of, 563
plumage color of, 562
record of, 562
weakness of, 562
Fowls
farm and Shanghais, 560
original homes of progenitors of present day breeds of domestic, 25
FOXWORTHY, F. W., cited, 551
FRANKE, KURT W., AND J. J. WILLAMAN, cited, 337
Fresh water shrimps, *see Palaemon sundaicus*
FRONDA, F. M.
A review: Practical poultry farming, 201
Accuracy in the weighing of experimental chickens, 511
cited, 26, 28, 103
The seasonal distribution of egg production: The normal egg production curve, 25
FRONDA, F. M., AND B. M. GONZALEZ. The Nagoya, a new immigrant from Japan, 559
FROMME, F. D., cited, 46
Fruit extension garden in Pasoeroean, 5
Fusarium
cepae, 301

oxysporum, 301
sp. 501
vasinfectum, 301
zonatum, 301

G

Gallagher, Wallace. The measure of a man, 116
Galvez, N., R. Moreno and V. G. Lava. Chemical studies on coconut products: II. Utilization of the coconut, 163
Gamo, Enrico B. A Fusarium bulb rot of onions, *abstract by* Pascual Robin, 645
Gaud-gaud, or porgy, *see Sparus calamara*
Gas, cyanide, 537
Gate, gravity, 117
materials for construction of, 119
methods of fastening and hanging, 119, 120
principle of, 121
Gay, Carl W., cited, 477
Get it done, 214
Gibbs, H. D., and F. Agcaoili, cited, 253
Gliricidia maculata, 46
Glossogobius giurus, 96, 256
Glycine
hispida, 188
max, 83
Ami, 84, 86
Otootan, 84, 86
Goats
dairies, 625
Indian and Nubian grades, 478
the trend of reproductive seasons of, 482
Goby, *see Glossogobius giurus*
Go Kee, Francisco. Notes on an outbreak of poultry epidemic, 263
Gonzalez, B. M.
cited, 361
Doctor Manuel L. Roxas: An appreciation, 197
Nagoya, the, a new immigrant from Japan, *see* Fronda, F. M., and B. M. Gonzalez
Published contributions of the College of Agriculture: VI, 635
vocational education, 1
Gomez, A. K. Pathological lesions caused by an undescribed Cooperia in a carabao, 169
Goodwin, W. H., cited, 538, 539
Gordon, Alexander
A gravity gate, or a simple self-closing gate, 117
A summary of studies on the depth of irrigation water for lowland rice in western Laguna, 579
Gordon's gravity gate, a word of comment on, 319
Gossard, H. A., cited, 538
Graham, Vere, and R. S. Carr, cited, 567
Grater for cassava
blades of, 596
box and stand of, 596
description of, 594
results of trials of, 596
wheel of, 595
Greenleaf, Walter J., mentioned, 269
Grunt, *see Pristopoma hasta* and *Pomadasis argyreus*
Guinea grass, 600
Gur and its prices in India, 270

H

Haberlandt, C., cited, 458
Habrobracon brevicornis, 398
Half-beak, *see Hemiramphus* sp.
Hammond, W. A., mentioned, 381, 384
Hands, farm, shortage of, 287
Hapalia
kasmirica, 397
lupulina, 397
Harengula moluccensis, 256
Harrow, disk, 493
methods of testing, 491
Harrow, John Deere, 492
Hartwell, B. L., and F. R. Pember, cited, 607
Hasa-hasa, *see Scomber japonicus*
Heat
as a means of controlling mill insects, 538
dry, effects of, on weevils in corn and on corn seeds, 537
regulation and control of, 540
Heating system, 537, 540
Heinrich, Carl. The main business of science, 331
mentioned, 397
Helminthosporium inconspicuum, 503
Helyar, F. G. Short courses in Agriculture, 211
Hemileia vastatrix, 45, 79, 317
Hemorrhagic septicemia, 371
Henry, W. A., cited, 367
Hens, Cantonese
copra meal and dried shrimps for, 95
egg production of, 97
observations on, 97, 100
mortality of, 101
testing the fertility of the eggs of, 97, 101
Herbert, D. A., cited, 333
Herrick, Glenn W.
cited, 538
mentioned, 542
Herring, *see Harengula moluccensis*

Hevea rubber, 22
Heyne, K. Nuttige Planten van Nederlandisch Indie, 7
Hibiscus cannabinus, 22
Hinds, W. E., and H. Spencer, mentioned, 380
Hind, E. W., and W. F. Turner, cited, 539
Hito, *see Clarias batrachus*
Hog
  corn and cassava as feeds for, 105
  ration, a study on the preparation of, 367
Holbert, J. R., and G. M. Hoffer, cited, 499
Holbert, J. R., C. S. Reddy, and B. Koehler, cited, 500
Holonisky, Franz, cited, 166
Homesteaders, a valuable aid to, 326
Horn, Walter, mentioned, 383
Horses, 599
  age of, 599
  American grade, 599
  Arabian infusion, 599
  breeding establishments of, 478
  calesa
    bathing of, 246
    concentrates given to, 244
    feeding of, 244
    grooming, 246
    native, 243
    relation of feed consumption to work done, 245
    roughages fed to, 244
    salting feeds for, 245
    scales for weighing, 244
    shoeing, 247
    stables for, 247
    trimming of mane and tail, and clipping of hair, 247
    watering, 245
    work performed by, 245
  heights of, 599
  native blood, 599
  Welsh blood, 599
  the trend of sexual reproductive seasons of, 480
Howard, Leland O., mentioned, 381
Huber, L. L., and C. R. Neiswander, cited, 398
Humphrey, C. J., note on, 329
Hurd, Louis M., mentioned, 201
Hybrids, means of multiplication of important, 11
Hydrogen ion in soils, 607
Hydrogen ion concentration of different buffer solutions, 337

I

Imms, A. D., mentioned, 382
Import duties in the Philippines, 351
Inciong, Antero P. A study of the feeding, care, and management of native calesa horses, at Los Baños, Laguna, 243
Income
  gross, 355, 357
  personal exemption from net, 357
  tax, 351
    calendar for farmers, 358
    forms, 359
    returns, 355, 357
Indigofera hendecaphylla, 21
Insects
  age of, 381
  control of, 537
  Malayan, left by Dean Baker, 200
  of the upper air, 383
  species of, 382
Insect pests, fumigant and heat as control of, 538
Insect zoo in Paris, 270
Insectary methods, 401
Institute, Japanese Imperial Government, 215, 216
    equipment of, 218
    origin of, 215
    personnel, 217
    present investigations in, 220
    published work of, 219
    salaries, 218
    work of, 218
International Education Board of New York, 3
Invaders, foreign insect, 384
Investigators in Java
  facilities for, and difficulties of, 5
  language preparation of, 5
  library of the department of agriculture for, 6
  location of main offices and laboratories, 5
  publications in Dutch, 6
Ips pini, 538
Isabela region, 567
Irrigation
  method of, 581
  water, 579

J

Jansen, B. C. P., cited, 166
Jaojoco, Felipe M., cited, 166
Japanese mackerel, *see Scomber japonicus*
Jardin des Plantes, 270
Java
  experiment stations, 5, 9, 16, 21
  Department of Agriculture, Commerce and Industry of, 5, 7
  private stations in, 16
  school of agriculture in, 8

JEANNEL, Dr., 270
Johnius belengeri, 255
JOHNSON, J. B., cited, 490
JONES, C. R., cited, 398, 488
JONES, JENKIN W., cited, 580
JULIANO, J. B., cited, 333

K

Kabasi, *sse Konosirus thrissa*
Kahlbaum antimony metal powder, 338
KALAW, MOISES M. Extension division notes, 267, 325, 467
Kandule, *see Arius* spp.
Kapok, Surinam, 22
KAUPP, B. F., cited, 103
KEGHIL, MAURICE DE, cited, 165
KENNARD, D. C. AND P. S. WHITE, cited, 103
KENNEDY, W. J., AND E. T. ROBBINS, cited, 368
Kjeldahl nitrogen determination, 509
Kids
  circumference of barrel, 630
  heart girth, 630
  height at withers, 630
  length of back and rump, 630
  width of rump, 630
  weighing and measuring of, 630
  weight, 630
KING, W. J., cited, 85
Kitang, *see Scatophagus argus*
Klaten, Tobacco Experiment Station at, 5, 16
KLOPPENBURG, C. A., cited, 166
KOBAYASHI, K., cited, 165
KOCH, L., mentioned, 4
Kolapo, *see Glossogobius giurus*
KOLTHOFF, I. M., AND B. D. HARTONG, cited, 337
Konosirus thrissa, 254
KRATZMANN, E., cited, 608
KRUPP, FRIEDRICH, mentioned, 491
Kuala Lumpur, Department of Agriculture and Forestry in, 5
Kulisic, *see Hemipterus japonicus*
Kulisig, *see Nemipterus sp.*

L

Labor, agricultural
  distribution of, 288
  supply of, 288
Labor problem solution, farm
  discourage emigration to Hawaii, 296
  improvement of roads, 298
  increase of wages and offer continuous work, 297
Labor supply, conditions affecting farm
  absence of good roads, 295
  differences in wages, 293
  emigration to Hawaii, 291
  geographical situation of country, 295
  school term coincides with working seasons, 295
  village system of government settlement, 295
Laborers, exodus of Filipino, 291
LA MER, V. K., AND T. R. PARSONS, cited, 341
Lagohot, *see Pristopoma hasta*
Land, delinquent, forfeited to government, 355, 357
Langil, *see Albizzia lebbek*
LANGWORTHY, C. F., cited, 260
Lansium domesticum, 22
Lapis, *see Scomberoides tol*
LARSON, A. O., AND C. K. FISHER, cited, 538
LAVA, V. G., AND E. D. HEMEDES. The behavior of the antimony electrode in buffered and unbuffered solutions, 337
LAVA, V. G., AND S. B. ETORMA. Comparative analysis of American and Philippine cigarettes, 565
Laying year for chickens, 27
Leather Jack, *see Scomberoides tol*
Legumes, correlation between the seed and straw production of some field, 83
Leguminosae, 551
Leersia hexandra, 137
  culture and cost of production, 137
  fertilization, 144
  plantation, site for, 138
  planting, 138
  preparation of field for, 138
  weeding, 142
LEONCIO, MARTIN O., cited, 97
LEONARD, W. A., cited, 166
Lepidoptera, 397
Lethal temperature
  determination of, 540
  for weevils, 537
Leucaena glauca, 21, 46
LEUKEL, R. W., JAMES G. DICKSON, AND A. G. JOHNSON, cited, 500
Liberalization of Philippine Land Law, 387
Licauc, *see Pristopoma hasta*
Liebig condensers, 510
Lifting device in recuperative work of trees, 93
Limestone sheep, 477
LIMPIADO, LEONCIO M. A comparative study of the growth and development of kids of milking and non-milking does, 625
LINDSEY, J. B., cited, 165
LINK, GEORGE K., AND ALICE A. BAILEY, cited, 301, 302
Litog, *see Arca granosa*
Loranthus philippensis, 80

M

Mabbun, Pablo N. Our farm labor supply, 287
Mackay, A., cited, 368
Mains, F. B., cited, 46
Maize, *see Zea mays*
Malay Peninsula, 551
Malayan Forest Department, 551
Mangifera indica, 89, 90
Mango, *see Mangifera indica*
Mango budding, 21
Manlit, *see Tridacna cumingii*
Mann, A. R., mentioned, 381, 384
Mariano, J. G., cited, 28
Mares
  grades with Arabian blood 478
  polyoestrous, 477
Marine eel, *see Muraenesox cinereus*
Marlatt, C. L., mentioned, 384
Marshall, Francis H. A., cited, 31, 477, 478
Marshall, Chief Justice, quoted, 351
Mayang, *see Drepane punctata*
Mean weights of experimental chickens, 513
Measuring instrument tor kids, 627
Mediterranean flour moth, *see Sitotroga cerealella*
Medrana, Constancio T., cited, 581
Megalops cyprinoides, 258
Mejia's hacienda at Puerto Bello, Ormoc, Leyte, 467
Melo aethiopica, 126
Mendiola, Nemesio B.
  A report of an agricultural investigation trip to Java, Federated Malay States and Borneo, 3
  Some possibilities in breeding plants for cover, green manure and shade, 159
Mercado, Toribio
  A report on the asexual inheritance of "many-eyed" character of sugar cane, 277
  Sugar cane breeding in the College of Agriculture V: Isolation of live cane arrows, and their use for hybridization, 527
Merrill, E. D., mentioned, 333
Milking does, 625
Milking stand, 626
Milkfish, *see Chanos chanos*
Miller, Hugo H., cited, 295
Millet, 398, 422
Mimosa invisa, 21
Mirasol, José Jison, cited, 607
Miyake, K., cited, 607
Modified Kjeldahl apparatus, 510
Moldboards and shares, scouring by, 487
Monamon, dilis, or anchovy, *see Anchovia commersoniana*
Mondoñedo, Mariano. A comparative study of corn and cassava as feeds for hogs. II. Ground corn vs. raw chopped cassava, 105
Mono-ammonium phosphate series, cultures of rice seedlings in, 40
Monohammus scutellatus, 538
Montalban, H. R., mentioned, 254
Montemayor, Zosimo. A promising cassava grater for the farm, 593
Morse, H. J., cited, 188
Mudfish, *see Ophicephalus striatus*
Mugil cephalus, 257
Mullet, *see Mugil cephalus*
Mumford, F. B., cited, 477
Mungo, *see Phaseolus aureus, also Phaseolus mungo*
Munro, R. W., and L. C. Brown, cited, 223, 233
Muraenesox cinereus, 257
Murex capucinus, 126
Murex ramosus, 126
Musa chilliocarpa, 21
Mycobacterium tuberculosis, 169

N

Napier grass, 600
Navarro, Andres, cited, 398
Nemipterus sp., 258; *Nemipterus japonicus*, 258
Nerita, 127
New College copra drier, 467
New Era Cowpea, *see Vigna sinensis*
Nichols, H. A. Alford, cited, 593
Nicotiana tabacum
  alafug, 568
  asparagin of, 565
  benzene extract of, 566
  burning quality of, 566
  carbohydrates of, 565
  certain definite qualities in, 565
  changes that take place in curing of, 565
  color of, 566
  Connecticut Havana, 568
  dry weight of, 565
  experiments, inquiry on, 11
  improved Gold Leaf, 568
  leaves, Isabela and Cagayan, 567
  Los Baños, 568
  nature of the aromatic substances in, 566
  nicotine content of, 565
  nitric acid of, 565
  phenols of, 566
  quality of, 565
  relation between quality and chemical characteristics of, 566
  Texas Cuban, 567

O

Occidental Negros Carnival, 110
Oil, ethereal, 565
Oil, west Africa palm, 91
Onion, *see Allium cepa*
Onion bulb rot, 301, 647
Ophicephalus striatus, 257
Ophiobolus heterostrophus, 503
Ordoveza, Ramon C. The culture and cost of production of barit in Bay, Laguna, 137
Organic acids, salts of, 565
Organization, system of farm, 2
Oryza sativa, 22
  effect of changing moisture content of soil upon, 173
  effect of nitrate and sulfate of aluminum on, 611
  effects of treatment upon the upland and lowland, 179
  external appearance of, 176
  improvement of, 12
  inbreeding of, 11
  number of days to maturity of, 175, 178
  plants
    air-dry weights of straw and grains of, 175
    average height at harvest, 175
    dry weight of, 610
    effects of aluminum salts added to good and poor culture solutions, 612
  physical and anatomical methods of selecting, 13
  single-salt stock solutions, 37
  solutions, culture, for young rice plants
    aluminum salts, 609
    four-salt solutions, 609
    preparation of, 38
    3-salt complete, 37
  station, Biggs, 580
  straw and grain from first planting of lowland set of, 177; of upland set of, 170
  straw and grain from second planting of lowland set, 178. of upland set, 177
  varieties of, 581
    Inintiw, 174
    Kumpol, 174
  yields, 583
Ostrea orientalis, 126
Our farm labor supply, 287
Oxyurichthys opthalmonema, 256
Oyster, *see Ostrea orientalis*

P

Paco, *see Pteris quadriaurita*
Paddies, preparation of, 581
Palad, *see Pseudorphombus neglectus*
Palaemon
  lanceifrons, 96
  sundaicus, 126, 130
Palisoc, E. Comparative nutritive values of different salts of ammonium, 37
Paller, Enrique M. The effects of dry heat on weevils in corn and corn seeds, 537
Palo, Macario A. A Fusarium causing bulb rot of onion in the Philippines, 301
Palos, *see Muraenesox cinereus*
Panicum spp., 398, 422
Pantaleon, Feliciano T. Effect upon rice plants of changing the moisture content of soil, 173
Pasoeroean
  breeding work in, 19
  sugar cane experiment station at, 5, 16, 18
Patanang, *see Murex ramosus*
Peanut, *see Arachis hypogaea*
Pearl, R., and F. M. Surface, cited, 29
Pegiña, Juan. The effect of borders in farm crops experiment, *abstract by* Clemente E. Yango, 385
Peltier, George L. A research delusion, address, 473
Pen and feed rack, 626
Penaeus sp., 130
Peña, Marcelo B. Corn production as affected by some common manures, *abstract by* Felix N. Camba, 323
Peralta, Fernando de. Third list of cyanophoric plants of the Maquiling region, 333
Pestalozzia palmarum, 223
  morphology of, 224
  mycelium of, 224
  pathogenicity of, 229
  physiology of, 227
  taxonomy of, 232
Pettit, R. H., cited, 422
Pfeiffer, T., A. Rippel, and C. Pfotenhauer, cited, 176
Phaeogenes planifrons, 398
Phaseolus areus, 83
  varieties of, 84, 86
Phaseolus calcaratus, 83, 86
Phaseolus mungo, 188
Philippine farmers' tax guide, 351
Philippine flowering plants, an enumeration of, 333
Philippine forests, 551
Philippine shell fish, proximate chemical analysis of, 125
Philips, A. G., R. H. Carr, and D. C. Kennard, cited, 103
Piatnitzki, M., cited, 566
Pineapple, sweetest varieties of Java, 22
Pinna virtaga, 128
Pigs
  Berkshire, 369
  care and management of, 370
  feeding of, 370

observations on, 370
weighing of, 370
Pioneering work, 325
Pisang sewoe, *see Musa chilliocarpa*
Plant breeding and improvement of some of the most valuable species now under cultivation, 160
Plant introduction from Java, 22
Plants
breeding for cover, green manure and shade, 159
cyanophoric, of Maquiling region, 333
Platycephalus indicus, 255
Plow
Chattanooga, reversible disk sulky, 188
John Deere, 492
Luzon Lagio—single-animal steel, 168
Native, 187
Prairie Queen Breaker, 188
stubble, 188
Plow and shares, tillage implements, 487
Plowing under legumes by single animal plows, 187
field used, 189
legumes used, 188
Plowshares, 494
forged, 491
maintaining suction of, 487
methods of testing, 492
Poisonous insects, bites of, 383
Pomadasis argyreus, 256
Pompano, *see Caranx malabaricus*
Porgy, *see Sparus calamara*
Poultry
epidemic, notes on an outbreak of, 263
use of, 511
Power of taxing the people and their property, 351
Practical Poultry Farming, a review of, 201
Preparation of scientific and technical papers, note on, 326
Pristopoma hasta, 256
Progressive Japan, 221
Pseudorhombus neglectus, 256
Pteris quadriaurita, 127
Public land
caution to applicants for, 326
developing a piece of, 206
Puccinia coronifera, 46
Puccinia sorghi, 46
Pullets, Cantonese, 96, 512
feed and feeding of, 96
flock of, 96
house for, 96
Pummelo, 21
Pumao, *see Tapes striatus*
Pusit, 130
Pyralidae, 397
Pyralis glabralis, 397
Pyrausta nubilalis, 397
adult female, 409
adult male, 402
alternate hosts, 422
annual number of generations, 417
control, 426
enemies of larvae, 422
enemies of pupae, 423
fifth instar larva of, 414
first instar larva of, 416
fourth instar larva of, 415
geographical distribution of, 398
life history and habits of, 417
pupa of, 410
seasonal occurrence and abundance of, 421
susceptibility of different corn varieties to, 422
synonyms, 397
systematic position of, 397
Pyrethrum flowers
exports of, 154
highest yield of, 153
in Japan, production of, 153
local consumption of, 154
quality determined by soil content, 153

Q

Quinine, *see Cinchona*

R

Ranching on the slopes of Taal volcano, 156
Ramos, José C. Notes on yield of some species of coffee grown on the College farm, 317
Ramsower, H. C., cited, 487, 488
Ratio between
soilage consumption and weight of horses, 605
Rations, normal egg laying, 26
Real property
assessed valuation of, 351
assessment of, 352
calendar for farmers, 358
forms, 359
levy and disposition of proceeds of, 352
redemption of, 355, 357
tax, 351
Real weights of birds, 513
Recuperative growth of plants, 89
Reddy, C. S. and J. R. Holbert, cited, 500
Reddy, C. S., J. R. Holbert, and A. F. Erwin, cited, 504
Reinking, Otto A., cited, 233, 499
Repollo, 568
Resananda, Nai Thongdee, cited, 27
Rhode Island Red eggs, 561
Ricafrente, Quirino P., cited, 580

Rice, *see Oryza sativa*
Richmond, G. F., cited, 167
Ridgway, Robert, mentioned, 310
Rivera, Bonifacio de, cited, 165
Roa, Manuel A. A word of comment on Gordon's gravity gate, 319
Robb, Walter, cited, 293
Robertson, Ralph D., cited, 579
Rockefeller Foundation, fellows of the, 3
Rodrigo, P. A.
  cited, 519
  Studies on the correlation between the seed and straw production of some field legumes, 83
  Yielding power of peanuts from cuttings of different ages, 519
Roselle, 22
Roxas, Doctor Manuel L.: An appreciation by B. M. Gonzalez
Roxas, Manuel L.
  cited, 253
  mentioned, 197
Rubber breeding, 16
  improvement of, 14
Rugg, W. C., and W. O. Pederick, listed, 33
Russell, H. L., mentioned, 4
Rynders, G. W., cited, 490

S

Sacay, Francisco M. An age of insects, not of man: Some notes of the Fourth International Congress of Entomology, 381
Saccharum officinarium
  age of plants potted, 531
  branching of, 277
  bud variations, 277
  cane hybridization, 527
  care and treatment of potted arrows, 533
  checkboard planting of, 533
  crossing, 531
  double eyes of, 278
  experiment station, 5
  eyeless node of, 277
  eyeless top ot flowering stalk of, 279
  field germination test of "many-eyed" variety versus Luzon White, 283
  germination of the eyes of, 277
  germination test of, 279
  germination under nursery conditions, 281
  healthy stalks, 528
  hereditary behavior of single and multiple eyes of, 281
  hybridization operations, 527
  Jeswiet study of hair groups of twin eyes of, 284
  many-eyed character of, 277
  mother plant, 531
  multiple eyes of, 278
  number of seedlings produced, 531
  parentage of one, two, and three visible eyes in each stalk, 280
  planting, checkboard system, 530
  potted arrows, 533
  potting, 528, 533
  recumbent stalks, 528
  stalk with eyes on each node at right angles, 277
  stalk with short joints, 277
  tillering habits of, 531, 532
  varieties of, 527
Saiki, Tadasu, mentioned, 215
Sample, bumping, frothing, and boiling over of, 509
Sampson, Hugh Charles, cited, 163, 164, 167, 233, 361, 362
Santiago, Moises S., cited, 95, 96
Santos, Adriano V. A review: Commercial timber trees of the Malay Peninsula, 551
Santos, Francisco O.
  cited, 95
  The Japanese Imperial Government Institute for Nutrition, 215
Sardine, *see Sardinella longiceps*
Sardinella longiceps, 258
Scatophagus argus, 258
Schmuck, A., and Balabuna Popzwa, cited, 566
Schools, specialized, 1
Schultze, W., cited, 398
Science
  the main business of, 331
  on the advancement of, by published papers, 395
Scomber japonicus, 256
Scomberoides tol, 257
Seale, Alvin, cited, 126, 129, 254
Seeds, vegetable, germination of, 452, 453, 454, 457, 458
Seeds, bean
  acceleration of destruction of, 539
  destruction of germination, 539
Seeds
  lettuce, germination in sand, 454
  pechay, germination in sand, 453
Seed bed and seedlings, 581
Serdang
  public garden at, 5
  experiment station at, 5
Serrano José A. A comparative study of the effect of copra meal and dried shrimps as supplements in rations for laying hens, 95
Shares, plow
  chilled cast iron, 490
  chromium plated soft center steel, 490
  Krupp steel, 490, 491

Sheep
Australian merinos, 477
Dorset horned breed, 477
Indian sheep, 477, 478
mutton, 477
the trend of reproductive seasons of, 482
wild goats, 478
Sherbakoff, C. D., cited, 310
Shive, J. W., cited, 37
Shober, J. B., cited, 166
Short courses in agriculture, 211
policies of, 211, 212
Shrimp, salt water, *see Penaeus* sp.
Shrimps, *see Palaemon lancifrons*
Silvanus surinamensis, 538
Silvestri, Filippo, mentioned, 382
Sitotroga cerealella, 538
Smith Hughes high schools, 212
Smith, William, cited, 368
Snapper, *see Nemipterus japonicus*
Snyder, E. F., cited, 383
Snyder, Morton. The tragedy of the unfit, 332
Society, needs of, 1
Soilage, consumption of, 601, 603, *see also* zacate, 599
Sorghum, 398, 422
Sornay, P. de, cited, 188
Southcombe, J. E., and Henry M. Wills, cited, 165
Soy bean, *see Glycine hispida* and *G. max*
Sparus calamara, 258
Species and evolution, 383
Spencer, M. Lyle. What a university should do for its students, 59
Spencer, S., cited, 367
Sphyraena acutipinnus, 254
Sphyraena jillo, 254
Spiers, S., and J. L. Bitte, cited, 165
Spillman, W. J., cited, 83
Staphylococcus
albus, 264
aureus, 264
Stevens, H. P., cited, 166
Stewart, J. H., and H. Atwood, cited, 368
Stiles, G. W. Jr., cited, 125
Stockdale, B. A., cited, 223, 232, 233
Stocklasa, J., cited, 608
Strombus canarium, 126
Suerte, Delfin. The composition of commercial sugar from Philippine centrals, 149
Sugar cane, *see Saccharum officinarium*
Sugar, composition of commercial, 149
Sulit, Victor S., cited, 95, 166
Sulfuric acid, salts of, 565
Sundarasinha, Charas S. Plowing under legumes by the use of single-animal plows, 187
Sunog, *see Platycephalus indicus*
Survey of Land Grant Colleges, 269
Susong tabang, 127
Susong dagat, *see Cerithium vertagus*

T

Taktakin, 121
Talakitok, *see Caranx malabaricus*
Taleon, Alejo T., cited, 103
Talitap-ong, *see Murex capucinus*
Tamban, *see Harengula moluccensis, also Sardinella longiceps*
Tapalang, *see Cyrena gigantea*
Tapes striatus, 129
Tarpon, *see Megalops cyprinoides*
Tax
collection of, 357
excise, 351
exemption from, 353
farmer's income, 355
fraudulent returns of income, 356
liability, 355, 357
levying and collecting, 351
payer, delinquent, 355, 357
paying population, 357
rate of, 357
Taxes, business, 351
Taxpayer, rights and privileges of, 357
Teacher, problem of agricultural, 1
Tellina incerta, 129
Tenebrioides mauritanicus, 538
Teodoro, A. L., cited, 189, 190
Tephrosia in coconut planting, 204
Testimony, 332
The measure of a man, 116
Therapon puta, 258
Tibangca, *see Nerita*
Tiglao, Simplicio. The relation of rainfall to the production of corn, *abstract by* Severino L. Salvador, 466
Tihim, *see Tellina incerta*
Tillyard, R. J., mentioned, 382
Tinikan, *see Anabas testudineus*
Tiny wasp, an ally of man against cane borer, 382
Tisdale, W. H., I. W. Taylor, R. W. Leukel, and Marion A. Griffiths, cited, 504
Tjinjiroean, Cinchona Experiment Station at, 5, 16, 17
Tobacco, *see Nicotiana tabacum*
Tractor
Fordson, 492
Samson, 492
Tragedy of the unfit, 332
Tribolium confusum, 537, 540
Tridacna cumingii, 128
Trip to Java, Federated Malay States and Borneo, agricultural investigation, 3

Tropical forestry, 551
Tunggo, *see Oxyurichthys opthalmonema*
Tunsoy, *see Harengula moluccensis*
Tuyo, or dried fish, 267

U

Uhl, A., and W. Kestranek, cited, 337
Umbrina russelli, 255
Unbalanced diet, influence of, 216

V

Velmonte, José E. Philippine farmers' tax guide, 351
Venkatraman, T. S., and R. Thomas, cited, 527
Ventura, Gaudencio A. Studies on the germination of vegetables seeds, 451
Vigna oligosperma, 21
Vigna sinensis, 83
Villa, Felix. Effect on young rice plants of adding aluminum salts to complete culture solutions, 607
Villegas, Valente
  cited, 478
  The trend of sexual and reproductive seasons among horses, cattle, water buffaloes, sheep and goats under Los Baños conditions: A preliminary report, 477
  Zacate and water consumption of Philippine horses, 599
Vista, T., cited, 361
Vocational teachers of Agriculture in North Carolina, 275
von Uffel, H., cited, 167
Vries, O. de, and E. Sidenius, cited, 566
Vrooman, Carl, mentioned, 269

W

Wade, J. S., cited, 398
Walker, J. C., cited, 315
Walker, J. C., and E. C. Tims, cited, 301
Walker, J. E., cited, 164
Wollenweber, H. W., C. D. Sherbakoff, O. A. Reinking, Helen Johann, and Alice A. Bailey, cited, 310
Water
  consumption of Philippine horses, 603
  extracts, 570
  for Philippine horses, 601
  gauge, 582
Weanlings, 513
Weed eaters, employing, 382
Weeds, eradication and controlling, 160, 537
Weevils, grain
  Bruchus quadrimaculatus, 539
  Bruchus obtectus, 539
  lethal temperature for, 542
What a university should do for its students, 59
Wheeler, W. P., cited, 368
White louse, 20
Williams, C. G., and J. B. Park, cited, 83, 86
Woodworth, H. E., cited, 422

Y

Yamao, S., cited, 608

Z

Zacate, 599
Zea mays
  Australian Yellow Dent, 540
  baluga, 540
  breeding, 13
  Calauan Yellow Flint, seed-borne flora of, 499
  Cagayan Yellow Flint, 540
  Cebu, 540
  damage by corn borer to, 397
  Diplodia-infected kernels, 500
  Diquet, 540
  Ferguson, 540
  fodder, 600
  grains, 537
  improvement, ear-remnant method of, 12, 13
  kernels, treatment of
    copper carbonate dust, 537
    copper
      colloidal, 500
      sulfate, 500
    Corona 640, 500
    Corona 640-S, 500
    Derris powder, 500
    Dipdust, Bayer's, 501
    Dust, Bayer's, 500
    formaldehyde, 500
    Germisan, 500
    Improved Semesan Jr., 500
    mercuric chloride, 500
    organic mercury compounds, 500
    special dust, 501
    Uspulun, 500
  inbreeding of, 11, 13
  Los Baños Yellow Dent, 540
  molds of, 501, 504
  Moro, 540
  pop, 540
  productivity, 537
  production, 13
    as affected by some manures, 323
  seeds
    effect of dry heat on, 542, 543, 546
  sweet, 540
  viability, 537
  vitality, 537
Zenillia roseanae, 398